AD NUMBER

AD910495

NEW LIMITATION CHANGE

TO

Approved for public release, distribution unlimited

FROM

Distribution authorized to U.S. Gov't. agencies only; Test and Evaluation; MAR 1978. Other requests shall be referred to Army Aviation Systems Command, Attn: AMSAV-EF, PO Box 209, St. Louis MO 63166.

AUTHORITY

usaavscom ltr, 12 nov 1973

AD ________________
RDTE PROJECT NO.
AVSCOM PROJECT NO. 70-15-3
USAASTA PROJECT NO. 70-15-3

VIBRATION AND TEMPERATURE SURVEY

CH-54B HELICOPTER

FINAL REPORT

ROBERT K. MERRILL
MAJ, FA
US ARMY
PROJECT PILOT

EMMETT J. LAING
PROJECT OFFICER/ENGINEER

JAMES S. REID
CW4, AVN
US ARMY

MARCH 1973

Distribution limited to United States Government agencies only; test and evaluation, March 1973. Other requests for this document must be referred to the Commander, United States Army Aviation Systems Command, Attention: AMSAV-EF, Post Office Box 209, St. Louis, Missouri 63166.

UNITED STATES ARMY AVIATION SYSTEMS TEST ACTIVITY
EDWARDS AIR FORCE BASE, CALIFORNIA 93523

DISCLAIMER NOTICE

The findings of this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

REPRODUCTION LIMITATIONS

Reproduction of this document in whole or in part is prohibited except with permission obtained through the Commander, United States Army Aviation Systems Command, Attention: AMSAV-EF, Post Office Box 209, St. Louis, Missouri 63166. The Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314, is authorized to reproduce the document for United States Government purposes.

DISPOSITION INSTRUCTIONS

Destroy this report when it is no longer needed. Do not return it to the originator.

TRADE NAMES

The use of trade names in this report does not constitute an official endorsement or approval of the use of the commercial hardware and software.

RDTE PROJECT NO.
AVSCOM PROJECT NO. 70-15-3
USAASTA PROJECT NO. 70-15-3

VIBRATION AND TEMPERATURE SURVEY

CH-54B HELICOPTER

FINAL REPORT

ROBERT K. MERRILL
MAJ, FA
US ARMY
PROJECT PILOT

EMMETT J. LAING
PROJECT OFFICER/ENGINEER

JAMES S. REID
CW4, AVN
US ARMY

MARCH 1973

Distribution limited to United States Government agencies only; test and evaluation, March 1973. Other requests for this document must be referred to the Commander, United States Army Aviation Systems Command. Attention: AMSAV-EF, Post Office Box 209, St. Louis, Missouri 63166.

UNITED STATES ARMY AVIATION SYSTEMS TEST ACTIVITY
EDWARDS AIR FORCE BASE, CALIFORNIA 93523

PRECEDING PAGE BLANK-NOT FILMED

FOREWORD

The United States Army Air Mobility Research and Development Laboratory (USAAMRDL), Eustis Directorate, Fort Eustis, Virginia, provided data reduction technical support through a contract with Northrop Corporation, Electronics Division, Palos Verdes Peninsula, California. USAAMRDL also provided instrumentation installation, calibration, and maintenance support. The dental work required to construct the pilot's bite block was provided by the Air Force Flight Test Center Dental Laboratory, Edwards Air Force Base, California. Wet Bulb Globe Temperature measurement equipment was obtained from the United States Army Medical Equipment Research and Development Laboratory, Fort Totten, New York. Technical advice on the measurement of pilot vibrations was obtained from the United States Army Aeromedical Research Laboratory, Fort Rucker, Alabama.

ABSTRACT

Vibration and temperature measurement tests were conducted on a CH-54B helicopter to define the vibration and temperature environment for the instruments, avionics, pilot station, and other component parts for representative flight conditions. Testing was performed by the United States Army Aviation Systems Test Activity, Edwards Air Force Base, California, between 22 August and 29 September 1972. The testing consisted of 16 flights totaling 18.5 productive test hours. Vibration data were recorded from 70 accelerometer locations for 55 flight conditions, and narrow band spectral analyses were performed on the vibration data. The results of the spectral analyses were summarized by use of statistical methods. Forward fuselage vibrations were primarily low frequency and were caused by the main rotor. Aft fuselage vibrations were primarily high frequency and were caused by gearbox and other rotating component vibration sources. The highest vibration levels were recorded at the auxiliary power plant at main transmission gear mesh frequencies. There were two shortcomings: amplification of main rotor-induced vibrations by avionics vibration isolation mounts, and excessively high Wet Bulb Globe Temperature index at the pilot station under certain environmental conditions.

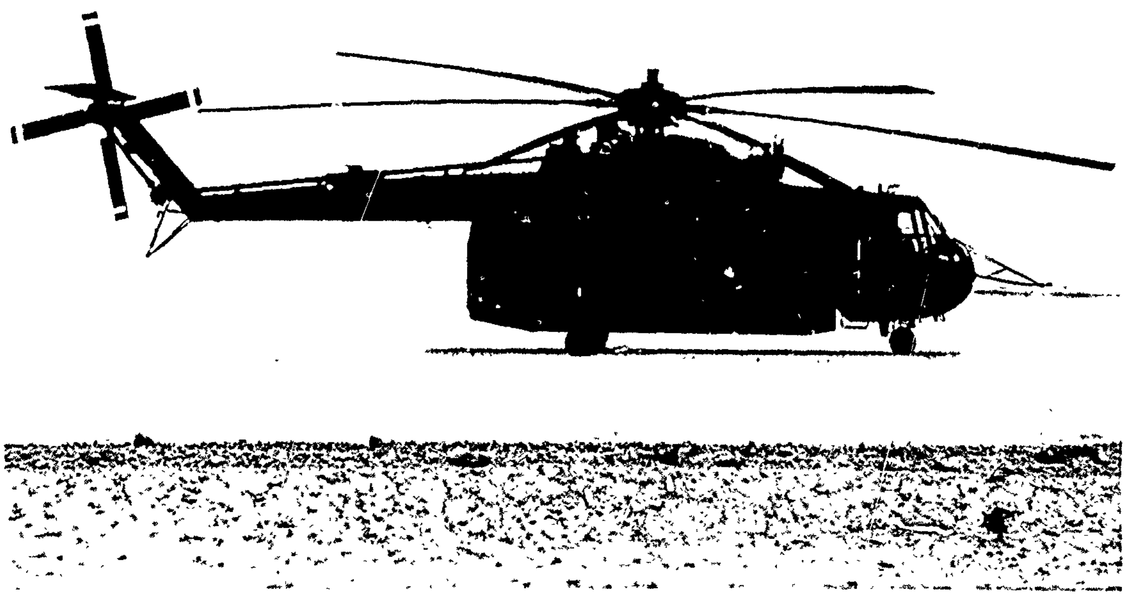


TABLE OF CONTENTS

INTRODUCTION

BACKGROUND

1. The failure rates of helicopter components such as instruments, avionics, gearboxes, bearings, pumps, etc., have reduced mission accomplishment and have increased the logistic support effort required to keep Army helicopters at the necessary level of operational capability. It is suspected that many component failures result from an excessive vibration and temperature environment and that the helicopter vibration and temperature environment may degrade pilot performance. However, there are insufficient data available to verify these suspicions. To obtain the data necessary to define the vibration and temperature environment of helicopter components and the pilot station, the United States Army Aviation Systems Test Activity (USAASTA) was directed (ref 1, app A) by the United States Army Aviation Systems Command (AVSCOM) to conduct a vibration and temperature survey on present-day Army helicopters.

2. This report on the CH-54B helicopter is the third of a planned series of six reports which will define the vibration and temperature environment of the OH-58A (ref 2, app A), UH-1H (ref 3), CH-54B, OH-6A, CH-47C, and AH-1G helicopters.

TEST OBJECTIVE

3. The objective of the entire environmental test project is to determine a representative vibration and temperature environment for all present-day Army helicopters. The objective of the CH-54B environmental survey was to determine the vibration and temperature environment of the CH-54B instruments, avionics, selected components, and the pilot station under all normal operating conditions.

DESCRIPTION

4. The CH-54B helicopter is an improved version of the CH-54A. Power for the CH-54B is furnished by two Pratt and Whitney model T73-P-700 gas turbine engines rated at 4800 shaft horsepower (shp) each for 30 minutes and 4430 shp for continuous operations (sea level, standard day). The helicopter is transmission-limited to 7900 shp for dual-engine operation and to 30 minutes single-engine operation at 4800 shp. A Solar model T-62T-16A1 or T-62T-16A2 gas turbine auxiliary power plant is provided for ground engine starting and operation of aircraft accessories during periods when the rotor system is not operating. The CH-54B design incorporates a single main lifting rotor and a tail rotor for antitorque and directional control. The main rotor is a six-bladed fully articulated system, and the tail rotor is a four-bladed semiarticulated system. Externally attached cargo or a detachable pod can be carried. The pod can be used to carry cargo and/or personnel internally or be equipped as a portable hospital

unit, a command post, etc. A capability for towing surface-type vehicles is also provided. The cockpit compartment has seats and controls for the pilot and copilot, and also for a pilot seated behind the copilot facing aft. Seating for two additional personnel is also provided. The helicopter has a fixed-tricycle landing gear with a full-swiveling nose wheel and dual main wheels. Brakes are provided for the main wheels only and can be activated by either the pilot or the copilot. There are no provisions for arming the helicopter. The instruments are rigidly mounted. Selected avionics items are mounted on vibration isolators. The avionics equipment on the test aircraft was as specified in the operator's manual (ref 4, app A) except for the AN/ARC-102 radio set, which was not installed. Detailed aircraft and flight instruments information may be found in appendix B and in the operator's manual.

SCOPE OF TEST

5. Vibration data were recorded during steady flight and maneuvering flight from 51 triaxial accelerometer locations, 10 biaxial accelerometer locations, and 9 uniaxial locations for 55 flight and ground conditions. Three configurations were tested: clean, 28,400 pounds; pod, 41,900 pounds; sling load, 41,900 pounds. The flight conditions and configurations tested are listed in table 1 and appendix C, respectively. Temperature data were recorded at 20 locations in flight and during static hot soaks in the sun. The accelerometer and thermocouple locations are described in appendix D and photographs of these locations are presented in appendix E. A total of 16 flights were conducted, consisting of 18.5 productive test hours, at Edwards Air Force Base, California. A comparison with selected previously gathered vibration data was made. The flight restrictions and operating limitations observed during this evaluation were as specified in the operator's manual (ref 4, app A). The flight conditions and configurations which will be used for future helicopter environmental testing are contained in the test plan (ref 5).

METHODS OF TEST

6. The test CH-54B helicopter (S/N 69-18463) was instrumented to record vibration data on a frequency multiplexed-frequency modulated (FM-FM) magnetic tape system. One hundred eighty-two channels of acceleration vibration data were recorded from accelerometers mounted on the instrument panel, avionics, pilot station, and other selected components. The instrumentation was limited to recording data from 12 accelerometer axes simultaneously with 8 manual switching groups. This switching enabled a total of 96 channels of vibration data to be recorded for each flight condition. To record the total of 182 channels, the accelerometers were relocated and all flight conditions were repeated. Twenty channels of temperature data were hand-recorded from a single temperature display by manually switching to the desired temperature pickup. The nose of the helicopter was pointed toward the sun for all temperature measurements. The parameters required to define the flight condition were hand-recorded from calibrated ship's standard instruments.

Table 1. CH-54B Vibration Test Conditions.

Test	Conditions[1]	Average Density Altitude (ft)	Average Temperature (°C)
Hover	In ground effect (IGE), clean, pod; out of ground effect (OGE), clean, pod, sling load.	4200	23
Level flight (LF)	V_H[2] (104 KCAS[3]), $0.9V_H$, $0.8V_H$, $0.7V_H$, V_{loiter} (55 KCAS); clean. V_H (100 KCAS), $0.9V_H$, $0.8V_H$, $0.7V_H$, V_{loiter} (55 KCAS); pod. V_H (90 KCAS), $0.9V_H$, $0.8V_H$, $0.7V_H$, V_{loiter} (55 KCAS); sling load.	5300	21
Climb	$V_{best\ R/C}$[4] (60 KCAS, $V_{cruise\ R/C}$ (80 KCAS); power for 2000 ft/min R/C, clean; maximum continuous power, pod, sling load.	5300	21.5
Descent	$V_{min\ R/D}$[5] (60 KCAS, minimum governing power; $V_{cruise\ R/D}$ (80 KCAS), 500 ft/min; clean, pod, sling load.	5300	21.5
Takeoff (T/O A)	From 10-foot hover, clean, pod; from 50-foot hover, sling load.	4100	22
Landing (LDG)	Landing A, to 10-foot hover, clean, pod; to 50-foot hover, sling load. Landing B, to touchdown, clean, pod.	4100	22
Maneuvering	90° turns at constant altitude, 100-KCAS entry airspeed, 15° and 30° bank angles, right and left, clean, pod; 90-KCAS entry airspeed, 10° and 20° bank angles, right and left, sling load.	5300	23
Ground run	Flight idle (185 rpm), ground idle (70 rpm), APP[6] only	4500	29

[1]Coordinated flight maintained at level flight, climb, descent, and maneuvering test conditions.
Average gross weights tested: 28,400 pounds, clean; 41,900 pounds, pod and sling load.
Main rotor speed: 100 percent (185 rpm).
[2]V_H: Maximum level flight airspeed.
[3]KCAS: Knots calibrated airspeed.
[4]R/C: Rate of climb.
[5]R/D: Rate of descent.
[6]APP: Auxiliary power plant.

7. A total of 10,019 vibration data records were recorded and narrow-band spectral analyses were performed on 9810 of these data records. To present the results of the spectral analysis in a form which could be more easily comprehended than the 9810 spectral analysis plots, a statistical method of summarizing the data on a digital computer (referred to as data compression) was developed. The data were compressed by selecting groups of the 9810 spectral analysis plots and summarizing each of these groups in two compressed data plots. These two compressed data plots show the maximum acceleration and the mean plus 3-standard-deviation (3-sigma) acceleration with the mean acceleration in the form of a frequency spectrum similar to the individual spectral analysis plots. The mean plus 3-sigma acceleration value is that acceleration below which 99.87 percent of all data recorded fell. Data compression was accomplished by taking the acceleration value at each of the 500 frequencies which were output by the spectral analyzer for all spectral analysis plots in a compression group and finding the maximum and minimum acceleration, the mean acceleration, and the mean plus 3-sigma acceleration. With the data compression plots which present the maximum acceleration values, a table is provided which lists the flight condition, accelerometer location, and axis at which each maximum acceleration occurred. The equations used to calculate the mean and standard deviation and a block diagram of the spectral analysis and data compression systems are presented in appendix F.

8. The flight conditions selected for the vibration testing were intended to cover all normal flight conditions encountered in operational use of the CH-54B helicopter. The first pass of the data compression grouped the data according to flight condition. The second and third data compression passes combined all of the flight conditions in proportion to the number of columns each flight condition occupies in the data array (figs. 1 through 3, app G). For example, landings comprise 5 out of 55 columns or 9 percent of the data which, in the compressions that combine flight conditions, represents a flight during which 9 percent of the flight time is spent in landings. The first-pass data compressions may be used to combine flight conditions in any proportion desired.

CHRONOLOGY

9. The chronology of testing was as follows:

Test request received	14 September 1970
Test aircraft available	18 July 1972
Test flying initiated	22 August 1972
Test flying completed	29 September 1972

RESULTS AND DISCUSSION

GENERAL

10. The CH-54B instrument and avionics vibrations were found to be primarily sinusoidal with a random variation of amplitude with time at each discrete frequency. The primary forward fuselage instrument and avionics vibration source was the main rotor with a maximum mean plus 3-sigma acceleration of 0.41g at the main rotor 6-per-rotor-revolution (6/rev) frequency of 18.5 hertz (Hz). The primary aft fuselage avionics vibration sources were gearboxes, shafts, and other rotating components with a maximum mean plus 3-sigma acceleration of 4.0g at 55.5 Hz. All instrument and avionics mean plus 3-sigma vibration levels were below the laboratory qualification vibration levels of MIL-STD-810B (ref 6, app A). The pilot seat pad did not attenuate main rotor-induced vibrations; however, vibrations above 10 Hz were attenuated by the pilot's body. The maximum mean plus 3-sigma vibration level for all locations tested was 117g at 1915 Hz at the auxiliary power plant. Main rotor-induced vibration harmonic content and amplitudes for the CH-54B were lower than those of the OH-58A and UH-1H helicopters. The CH-54B aft fuselage vibration levels from 50 Hz to 2000 Hz were higher than the aft fuselage vibration levels of the OH-58A and UH-1H helicopters. The highest instrument and avionics temperatures were recorded in the cabin area under static conditions and decreased in forward flight. Under certain environmental conditions the Wet Bulb Globe Temperature index is excessively high at the pilot station. The results of this test indicate the data in this and previous environmental test reports should be applied to revising the appropriate military environmental specifications and improved vibration isolation methods should be developed.

VIBRATION DATA

Data Relevancy

11. Experience shows that there is a wide variation in the vibration level of different helicopters of the same model due to differences in the mechanical condition of each helicopter. Thus, if vibration levels are to be measured which are representative of those encountered in a particular model of helicopter, then a sample of several units of this model of helicopter must be tested. All of the data in this report are from one CH-54B helicopter, S/N 69-18463, which was obtained from Sikorsky Aircraft by USAASTA with 317 flight hours and accumulated 70 additional flight hours at USAASTA before this vibration test was conducted.

Data Presentation

12. The data were summarized in three data compression passes and in 10 special-purpose compressions. Each data compression is presented as two plots: maximum acceleration recorded versus frequency and mean with mean plus 3-sigma acceleration versus frequency. The mean plus 3-sigma acceleration values are felt to best represent the test data, since accelerations in excess of the mean plus 3-sigma limit were recorded less than 0.13 percent of the time. This result indicates that accelerations in excess of the mean plus 3-sigma limit would be only rarely encountered in operational use of the helicopter. The data grouping used in each compression pass are summarized in table 2, with details of the data compression shown in the data arrays (figs. 1, 2, and 3, app G). In the data array, each square represents a spectral analysis data point. The numbers assigned to each group of squares in the data array represent a compression group, with squares with like numbers belonging to the same compression group. This compression group number is written on each compressed data plot for identification. The special-purpose compressions combine all axes and flight conditions for the accelerometer locations of interest. The special-purpose compressions were used to determine transmissibility and pilot station vibrations. The specific locations compressed are indicated on transmissibility and pilot station vibration plots.

13. The instrument and avionics third-pass compression results are presented in table 3 and in figures A and B in the body of this report. The second-pass compression results are presented in appendix G for all accelerometer locations. Only the instruments, avionics, and pilot station compressions are presented in appendix G for the first pass compressions. The first pass compressions for the other locations are available from USAASTA. For the second and third compression passes a table is presented with the plot of the maximum accelerations which lists the accelerometer location, axis, and flight condition at which each significant peak occurred. For the third pass compression this table is expanded to include the source of the significant accelerations. The acceleration values which are presented in this report are one-half of the peak-to-peak value. The individual spectral analysis data, on digital magnetic tape, are available from USAASTA.

Instrument and Avionics Vibration

14. Instrument and avionics vibration data were gathered from 16 triaxial accelerometer locations at the test conditions shown in table 1. Accelerometer locations are described in detail in table 2, appendix D, and shown in photographs in appendix E. The third pass forward fuselage data compressions are presented in figures A and B in the body of this report. Second pass data compressions are presented in figures 4 through 9, appendix G, and first pass data compressions are presented in figures 53 through 94, appendix G. The data were found to be primarily sinusoidal with a random variation of acceleration amplitude with time at each discrete frequency. The random amplitude variation was usually less than 30 percent of the acceleration amplitude mean value and was apparently due to small changes in variables such as light turbulence or small control inputs. There was a significant difference in vibration frequency content between the forward

Table 2. Data Compression Grouping.

Compression Pass	Group[1]	Group Elements (location number)	Number of Group Elements	Number of Compressions
1st	Equipment	Instruments (1, 2, 3, 4, 5, 6, 7) Avionics, forward fuselage (8, 9, 10, 11, 12, 13) Avionics, aft fuselage (14, 48, 56) Pilot input (15, 16, 17, 18, 19) Pilot output (20, 21) Tach generators (22, 23, 24) Transmission mounts (25, 26, 27, 28) Upper main transmission (29) 45° and 90° gearboxes (30, 31) Hanger bearings (32, 33, 34, 35, 36) Hydraulic system (37, 38, 39, 40, 41, 55) Oil cooler (42, 43) Fuel pressure switches (44, 45) Brake cylinder (46) Rotor brake support (47) Cockpit blower (49) Horizontal stabilizer tip (50) Anticollision light (51) Primary servo actuators (52, 53) AFCS servo (54) Auxiliary power plant (57, 58) Engine mounts (60, 61, 62, 63, 64) Engine (65, 66, 67, 68, 69, 70)	24	[3]168
	Flight conditions[2]	Hover Level flight Climb Descent Takeoff and landing Turns Ground run	7	
2nd	Equipment	Same as 1st pass	24	24
	Flight conditions	All	1	
3rd	Equipment	Instruments and avionics (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13)	1	1
	Flight conditions	All		

[1]All axes combined for all compressions.
[2]Flight conditions described in detail in table 1.
[3]Two additional compressions consisting of locations 57 and 58 combined, and location 44, were calculated for the APP-only ground test condition.

Table 3. Instruments and Avionics Maximum Accelerations for Figure A.[1]

Frequency (~ Hz)	Flight Condition[2]	Configuration	Axis	Location Number	Amplitude (~ g)	Source
5	OGE	Sling load	Longitudinal	7	0.54	--
12	LDG A	Pod	Longitudinal	7	0.22	--
18	LDG A	Pod	Longitudinal	7	0.70	Main rotor 6/rev
37	LDG A	Pod	Longitudinal	2	0.73	Main rotor 12/rev
50	Left, 25°	Pod	Longitudinal	1	0.16	Tail rotor drive shaft
56	LDG B	Clean	Longitudinal	1	0.17	Main rotor 18/rev
74	V_{cruise} R/C	Clean	Longitudinal	1	0.15	Main rotor 24/rev
256	LDG A	Pod	Longitudinal	12	0.24	Gas producer
368	LF (V_H)	Clean	Lateral	13	0.35	--

[1]All instruments and forward fuselage avionics.
[2]Flight condition abbreviations defined in table 1.

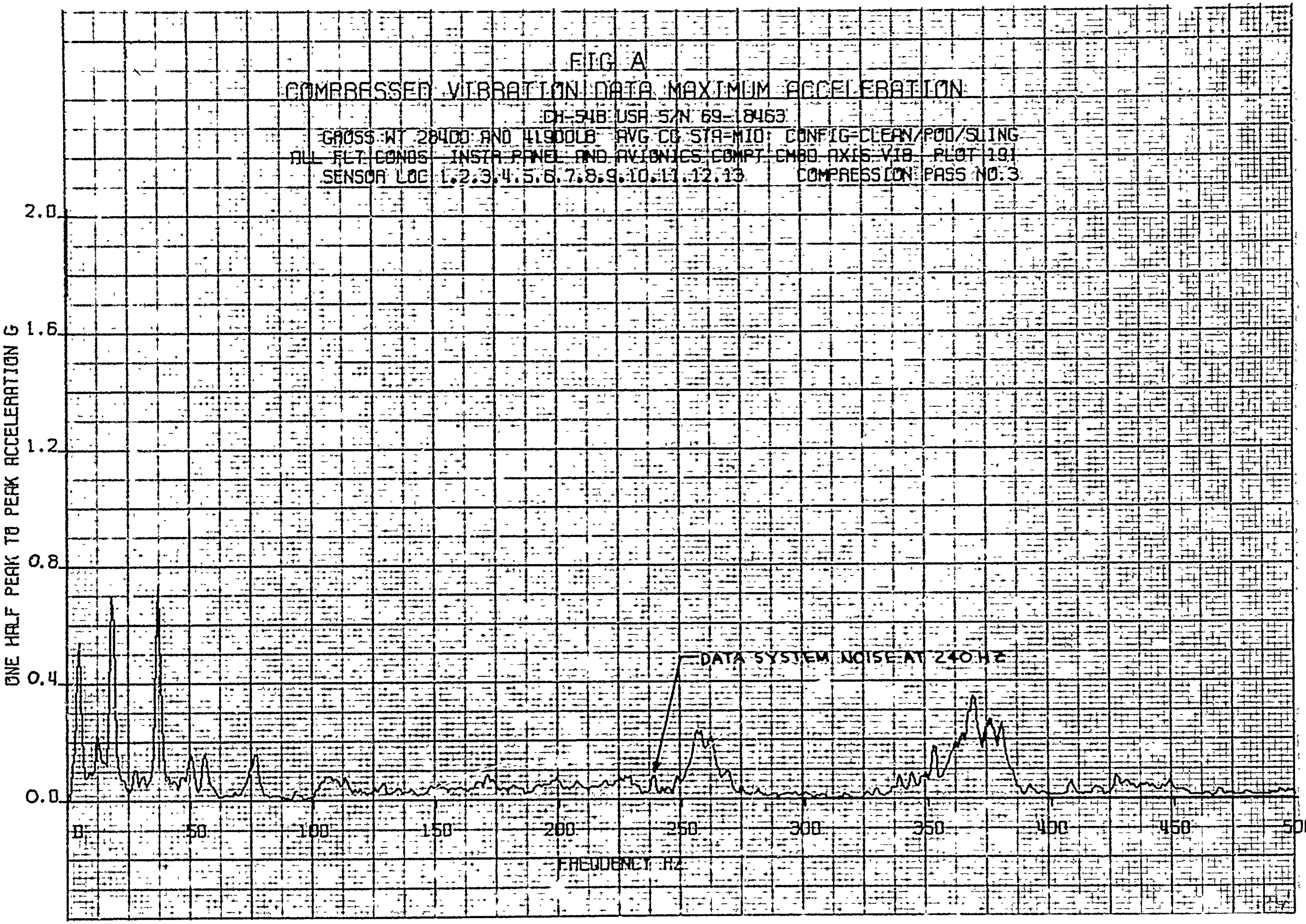


FIG A
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA=MID CONFIG=CLEAN/POD/SLING
ALL FLT CONDS INSTR PANEL AND AVIONICS COMPT CMBD AXIS VIB PLOT 191
SENSOR LOC 1.2.3.4.5.6.7.8.9.10.11.12.13 COMPRESSION PASS NO.3
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

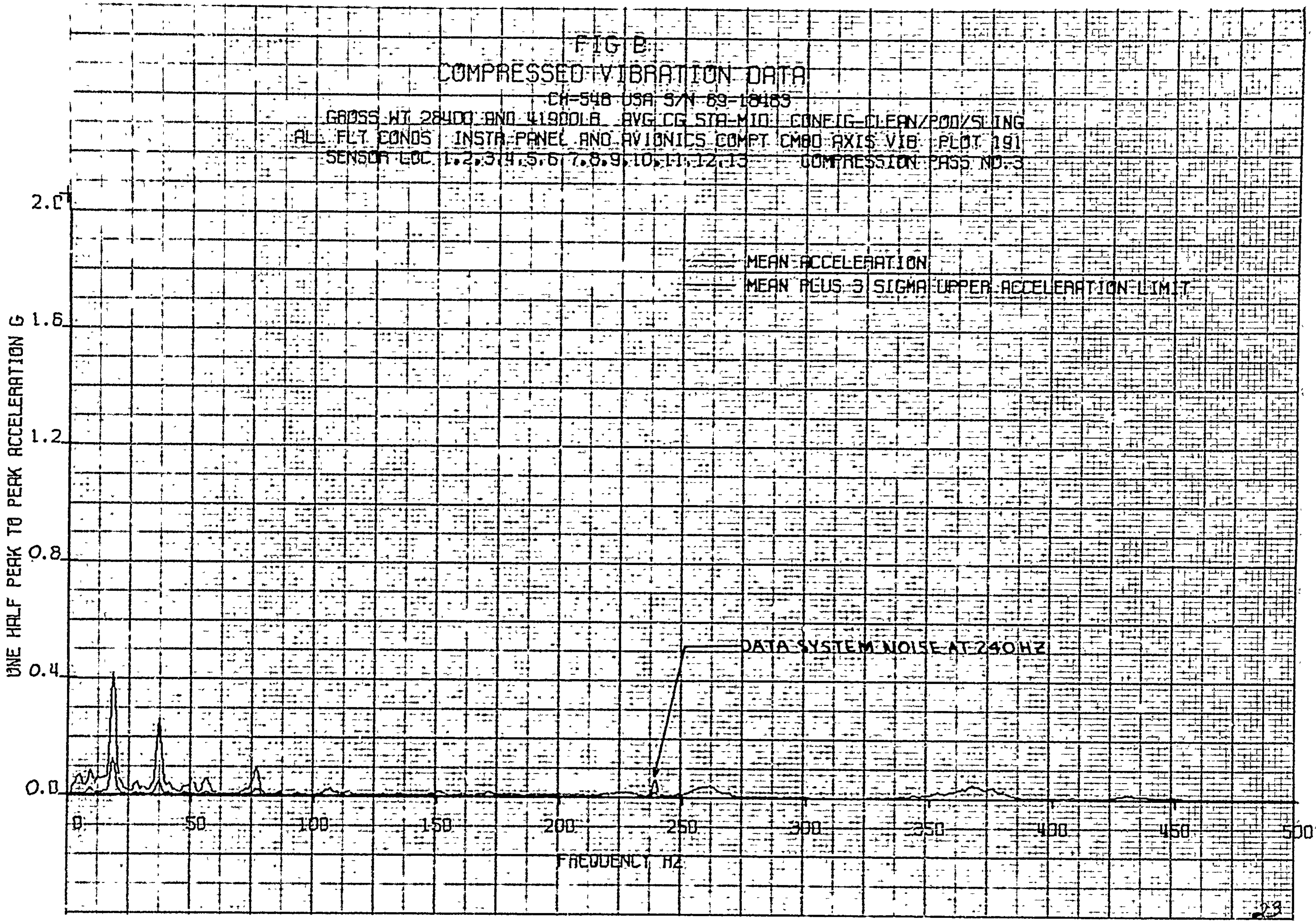


FIG 8
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
ALL FLT CONDS INSTR PANEL AND AVIONICS COMPT CMBD AXIS VIB PLOT 191
SENSOR LOC 1,2,3,4,5,6,7,8,9,10,11,12,13 COMPRESSION PASS NO.3
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ
23

and aft fuselage areas. In the forward fuselage area the main rotor was the primary vibration source, with the tail rotor drive shaft and engine also causing significant vibrations. In the aft fuselage area the primary vibration sources were the tail rotor, tail rotor drive train, main transmission, and numerous other rotating components located in the main transmission area. Table 4 lists the primary CH-54B vibration sources and their frequency at 100 percent main rotor speed. Main rotor speed was set at 100 percent ±1 percent during this testing. In the forward fuselage area a maximum mean plus 3-sigma acceleration value of 0.42g at the main rotor 6/rev frequency of 18.5 Hz was recorded (fig. B). A peak acceleration value of 0.74g at the main rotor 12/rev frequency of 37 Hz (fig. A) was recorded along the longitudinal axis on the lower right portion of the instrument panel (location 7) during a landing. Low-level vibrations at main rotor noninteger harmonics of 3/rev (9.2 Hz) and 9/rev (27.7 Hz) frequencies were consistently observed with a maximum mean plus 3-sigma acceleration of 0.08g at 9.2 Hz. Vibrations at frequencies of 5 Hz and 12 Hz were also occasionally observed. In the aft fuselage area (figs. 8 and 9, app G) vibrations were of higher amplitude and frequency than in the forward fuselage area. A maximum mean plus 3-sigma acceleration of 4.0g was recorded at the tail rotor 4/rev and main rotor 18/rev frequency of 55.5 Hz. A peak acceleration of 5.03g was recorded at the main transmission first stage planetary gear mesh frequency of 1400 Hz along the lateral axis at the automatic flight control system transducer package (location 14) during a 25-degree bank left turn.

Comparison with the Military Standard

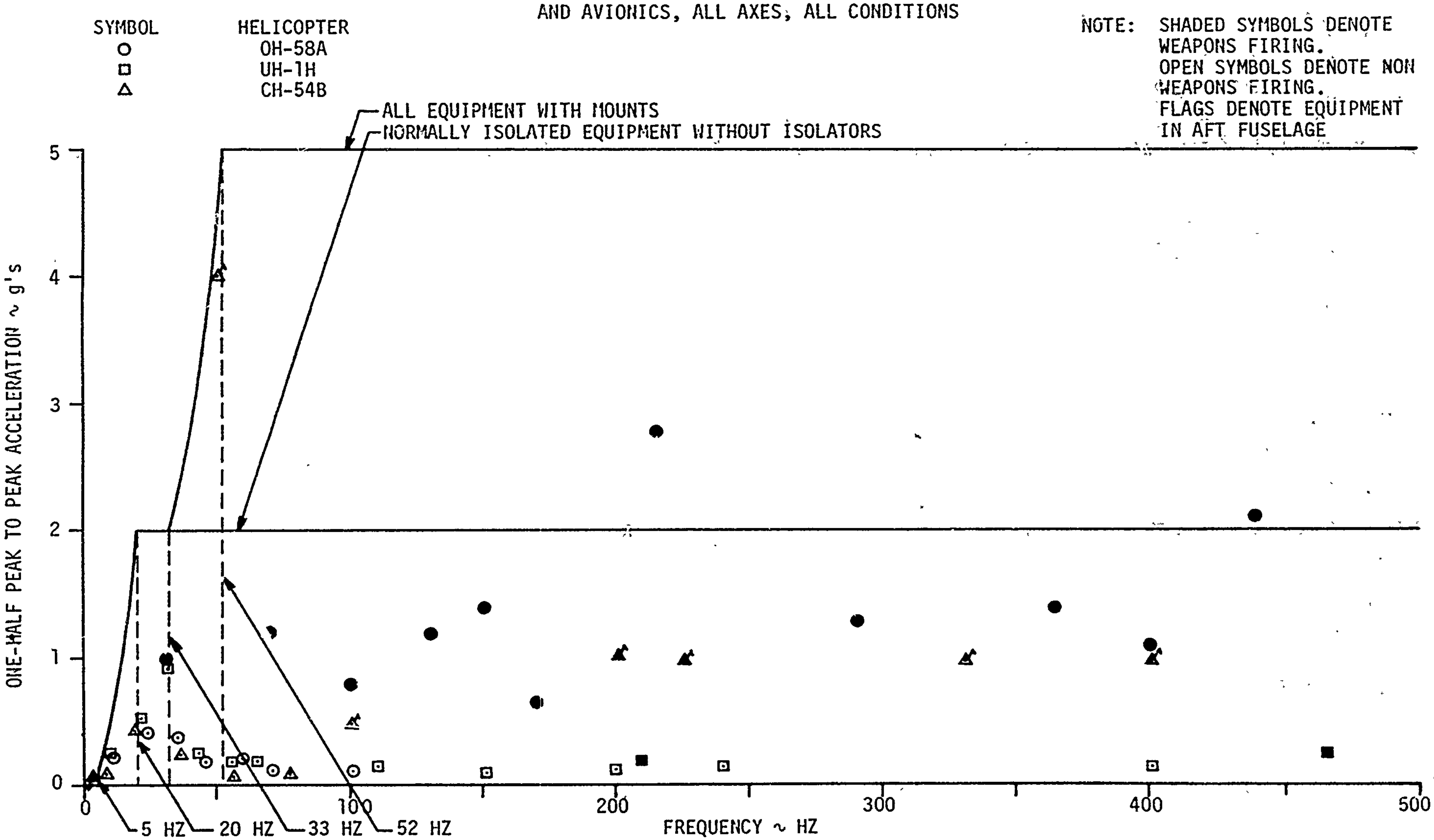
15. Figure C shows a laboratory vibration test curve for equipment installed in helicopters taken from figure 514.1-3 of the military standard, MIL-STD-810B (ref 6, app A). The ordinate is changed from units of vibration amplitude as the curve is presented in MIL-STD-810B to units of vibration acceleration to be compatible with the data presented in this report. The significant mean plus 3-sigma acceleration and limits from figure B and figure 9, appendix G, are plotted on this specification curve with previously acquired OH-58A vibration data (ref 2, app A) and UH-1H vibration data (ref 3). This specification curve does not limit helicopter instrument and avionics vibration levels but gives vibration levels to be used for laboratory qualification of instruments and avionics for helicopter use. A data compression composed of only equipment mounted on isolators was not calculated, since the lower curve of figure C assumes that the vibration isolators will reduce vibrations above a frequency of 33 Hz, which was not the case for the vibration isolators tested. All instrument and avionics mean plus 3-sigma vibration levels are below the test curve of MIL-STD-810B. The forward fuselage-mounted equipment vibration levels are well below the test curve of MIL-STD-810B, while the aft fuselage-mounted equipment vibration levels are higher and approach the test curve of MIL-STD-810B in the 50-Hz area.

Table 4. CH-54B Vibration Sources.

Main rotor speed: 185 rpm

Source		Frequency (~ Hz)
Main rotor	Fundamental	3.1
	6/rev	18.5
	12/rev	37.0
	18/rev	55.5
	24/rev	74.0
	30/rev	92.5
Tail rotor	Fundamental	14.1
	4/rev	56.4
	8/rev	113.0
	12/rev	169.2
	16/rev	225.6
	20/rev	282.0
Tail rotor drive shaft (engine to 45° gearbox)	Fundamental	50.3
Tail rotor drive shaft (45° gearbox to 90° gearbox)	Fundamental	41.1
Gas producer (100 percent)	Fundamental	267
Power turbine (100 percent)	Fundamental	150
90° gearbox gear mesh	Fundamental	864
45° gearbox gear mesh	Fundamental	1352
Main transmission input bevel gear mesh	Fundamental	1910
Main transmission first stage planetary gear mesh	Fundamental	1386
Main transmission second stage planetary gear mesh	Fundamental	711

FIGURE C
COMPARISON WITH LABORATORY VIBRATION TEST CURVES FOR EQUIPMENT INSTALLED IN HELICOPTERS
CURVES FROM MIL-STD-810B, FIG 514.1-3
MEAN PLUS 3 SIGMA ACCELERATION, ALL INSTRUMENTS
AND AVIONICS, ALL AXES, ALL CONDITIONS



Isolation Mount Characteristics

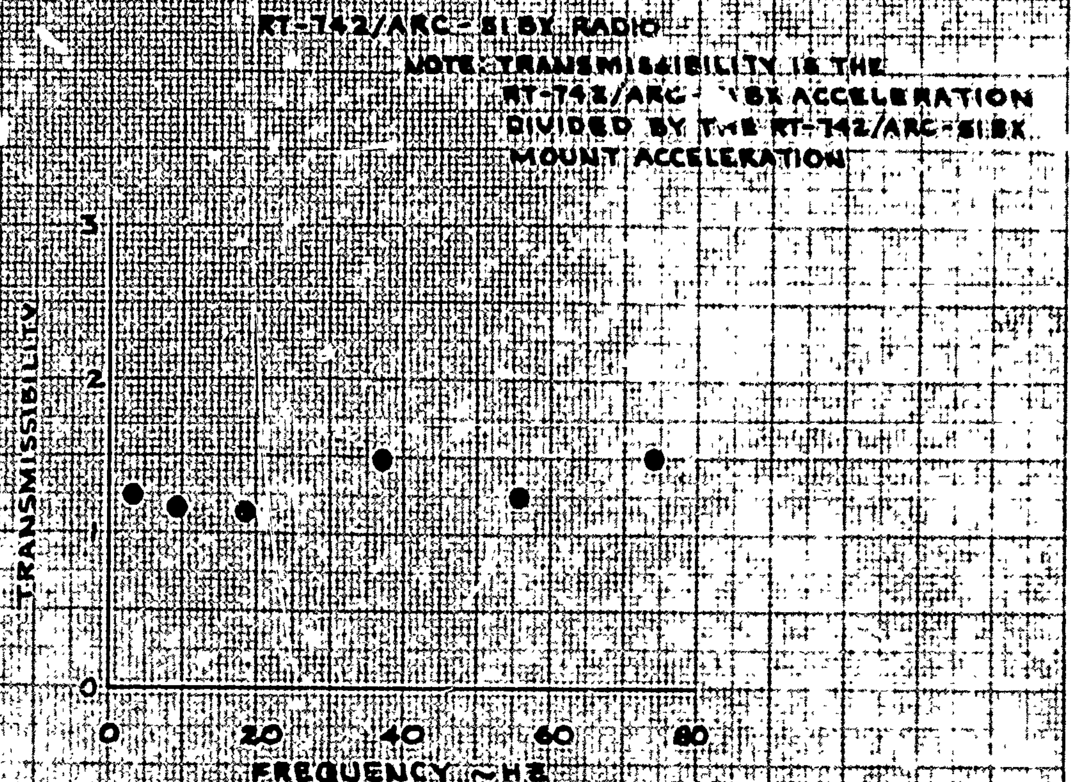
16. The transmissibility of the isolation mounts on the RT-742/ARC-51BX radio and CN-998/ASN-43 directional gyro was evaluated at the CH-54B driving frequencies. Transmissibility was determined by measuring the input and output accelerations across the isolation mounts and calculating the ratio of output to input acceleration. The input and output accelerations used were those determined from the mean plus 3-sigma compressions of all axes and all flight conditions. This ratio is plotted as a data point at each driving frequency in figure D. The results indicate that the isolation mounts significantly amplify CH-54B driving frequencies below 74 Hz for the RT-742/ARC-51BX radio and between 5 Hz and 40 Hz for the CN-998/ASN-43 directional gyro. This amplification is apparently due to isolator resonant frequencies which are near the helicopter driving frequencies. Above 40 Hz, the directional gyro isolation mounts were effective; however, the ARC-54BX radio isolation mounts were not effective at any measured driving frequencies. The amplification of vibrations in this low-frequency range is highly undesirable, since severe CH-54B instrument and avionics vibrations occur at these low frequencies. Amplification by the vibration isolators is a shortcoming, correction of which is desirable. Improved vibration isolation for instrument and avionics components should be provided.

Pilot Station Vibrations

17. Pilot station vibrations were measured at the pilot collective grip, cyclic grip, right pedal foot rest, seat structure, seat pad, bite block, and helmet at the conditions shown in table 1. Accelerometer locations are described in detail in table 2, appendix D, and are shown in photographs in appendix E. The second-pass data compressions are presented in figures 10 through 13, appendix G, and the first-pass data compressions are presented in figures 95 through 122. The pilot for which this data were recorded weighed 175 pounds and was 68 inches tall. Fifty pounds of ballast was placed on the floor beneath the pilot seat to simulate the fuselage response due to a 225-pound pilot station loading.

18. The transmissibility of the seat pad was evaluated by calculating the ratio of the seat pad acceleration to the seat structure accelerations at CH-54B driving frequencies. These ratios are plotted in figure E. Seat pad acceleration was measured by attaching an accelerometer to the bottom of a 10-inch by 6-inch by 0.020-inch aluminum plate on which the pilot sat. The accelerations used were those determined from the mean plus 3-sigma compressions of all axes for the seat pad and seat structure. Results indicate that there is little attenuation of seat structure vibrations by the seat pad in the frequency range of main rotor-induced vibrations. Since vibrations are induced by the main rotor, consideration should be given to use of a seat cushion which would attenuate vibrations in the frequency range of the main rotor.

FIGURE D
VIBRATION ISOLATOR TRANSMISSIBILITY
CH-54B USA S/N 69-18462
ALL AXES COMBINED
ALL FLIGHT CONDITIONS



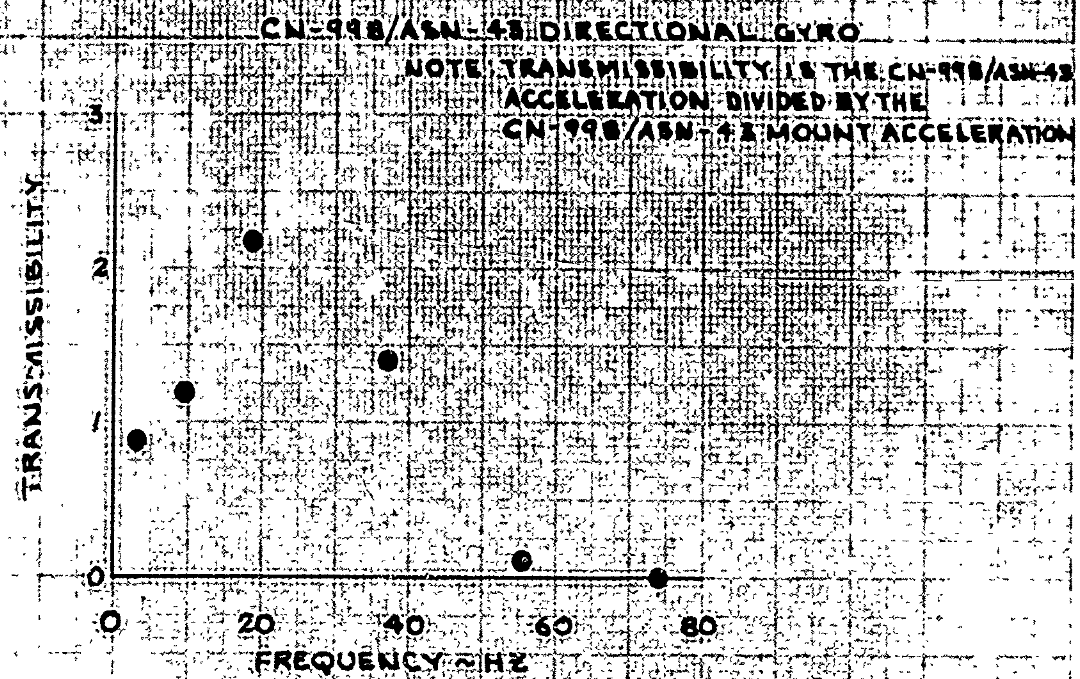
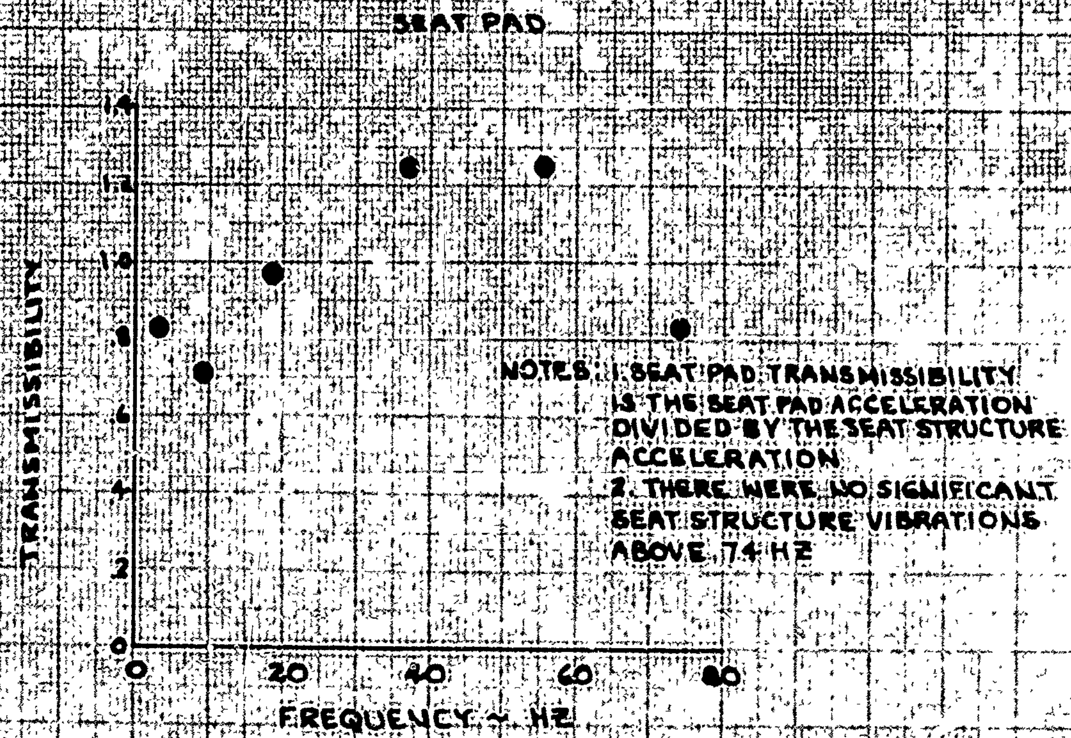
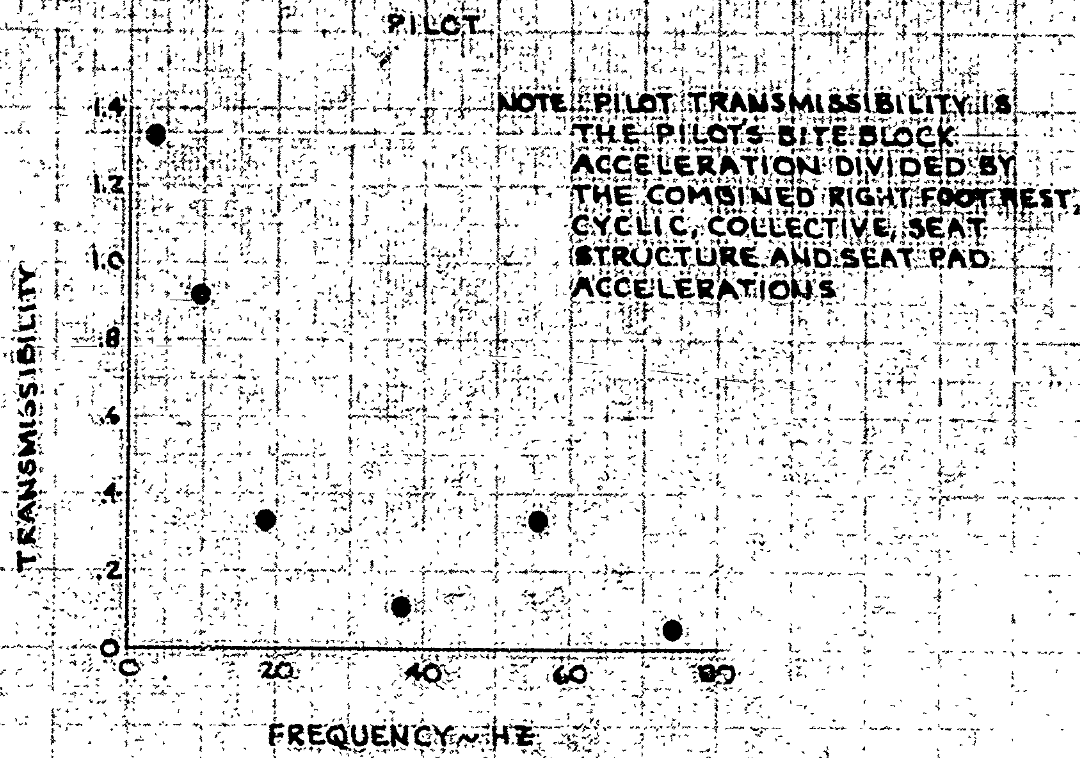


FIGURE E
SEAT PAD AND PILOT TRANSMISSIBILITY
CH-54B USA S/N 69-18463
ALL AXES COMBINED
ALL FLIGHT CONDITIONS





19. The pilot's head vibrations were measured with an accelerometer attached to a bite block. The bite block was a plastic and aluminum form shaped to fit the pilot's teeth which the pilot held securely in his mouth when vibrations were recorded from this location. The ratio of the bite block acceleration to the combined collective grip, cyclic grip, right pedal foot rest, seat structure, and seat pad accelerations was calculated and is presented as pilot transmissibility in figure E. The results show that the pilot's body attenuates vibrations above 10 Hz. The pilot station vibration limits of paragraph 3.7.1b of MIL-H-8501A (ref 7, app A) are compared to the seat structure mean plus 3-sigma accelerations for all axes in figure F. The data are divided into two groups: hover, level flight, climb, and descent compose one group while takeoff, landing, and turns compose the other group. There is no specification limit on vibration levels during maneuvering flight, so these data were combined with the takeoff and landing transition data, since most maneuvers are transient conditions. There is a specification vibration limit for flight from V_{cruise} to V_{limit} airspeeds but no data were grouped for this condition, since the V_{cruise} and V_{limit} airspeeds are identical for the CH-54B helicopter. The results show that specification requirements were not exceeded. The highest vibration levels were at the main rotor 6/rev frequency with the magnitude of vibrations at all other frequencies well below those at the 6/rev frequency.

Selected Component Vibration Characteristics

20. Vibration data were recorded at 47 locations throughout the helicopter other than instruments, avionics, and the pilot station. These locations are described in table 2 and appendix D and are shown in photographs in appendix E. Data were recorded at the test conditions listed in table 1. These vibration data were recorded at the request of the United States Army Air Mobility Research and Development Laboratory (USAAMRDL), Eustis Directorate, and were transmitted to USAAMRDL in the Northrop Corporation data report (ref 8, app A). The selected component second-pass data are presented in this report in figures 14 through 52, appendix G. The selected component first-pass data are not presented in this report but are available from USAASTA.

21. The vibration characteristics at these 47 locations will not be discussed in detail but, in general, show the presence of high-level, high-frequency vibration near rotating equipment, particularly gearboxes. The maximum mean plus 3-sigma vibration acceleration level recorded for all locations was 117g at 1915 Hz at the APP (fig. 45, app G). The source of this APP vibration was identified as the main transmission input bevel gear mesh frequency.

Comparison with Previous Environmental Test Data

22. Vibration data gathered from the OH-58A helicopter (ref 2, app A) and the UH-1H helicopter (ref 3) are compared with the CH-54B vibration data in figure C. The primary CH-54B main rotor-induced vibrations were at the main rotor first (6/rev) harmonic frequency with some significant vibrations at the main rotor second (12/rev) harmonic frequency. The primary OH-58A and

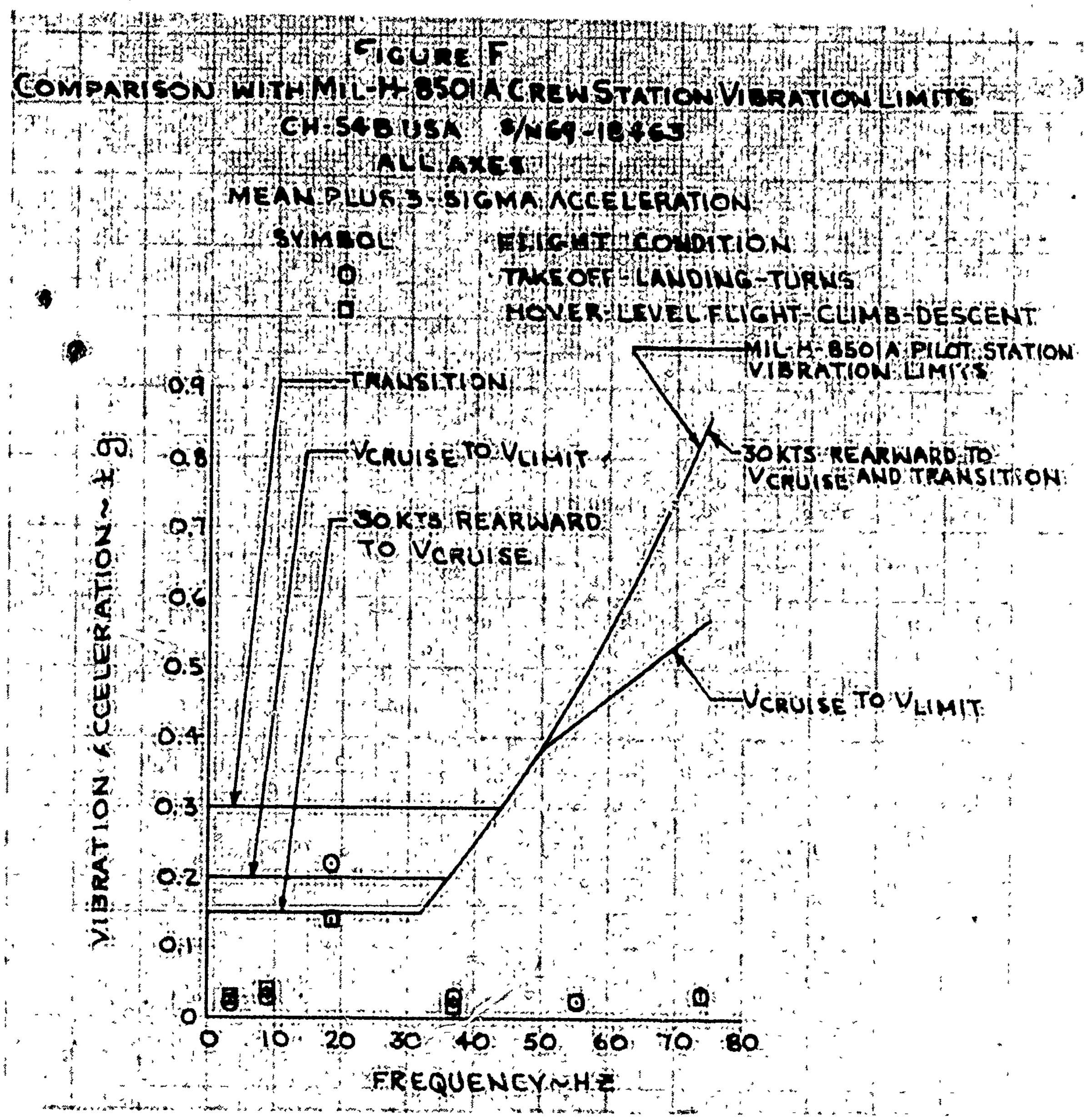


FIGURE F
COMPARISON WITH MIL-H-8501A CREW STATION VIBRATION LIMITS
CH-54B USA S/N69-18463
ALL AXES
MEAN PLUS 3-SIGMA ACCELERATION
SYMBOL
FLIGHT CONDITION
TAKEOFF-LANDING-TURNS
HOVER-LEVEL FLIGHT-CLIMB-DESCENT
MIL-H-8501A PILOT STATION VIBRATION LIMITS
TRANSITION
VCRUISE TO VLIMIT
30 KTS REARWARD TO VCRUISE
30 KTS REARWARD TO VCRUISE AND TRANSITION
VCRUISE TO VLIMIT
VIBRATION ACCELERATION ~ ± g
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 10 20 30 40 50 60 70 80
FREQUENCY ~ HZ

UH-1H main rotor-induced vibrations were at the main rotor first (2/rev), second (4/rev), and third (6/rev) main rotor harmonic frequencies, with significant vibrations up to the main rotor ninth or tenth harmonic frequencies. The CH-54B main rotor-induced vibrations showed less main rotor harmonic frequency content and their levels were lower than those of the OH-58A and UH-1H helicopters. However, the aft fuselage vibration levels from 50 Hz to 2000 Hz were higher in the CH-54B than in the OH-58A and UH-1H helicopters.

TEMPERATURE DATA

Component Air Temperatures

23. Component-part surrounding air temperatures were recorded at 20 locations described in table 3, appendix D, and are shown in photographs in appendix E. Temperatures were recorded for static hot soaks in the sun, level flight between 60 and 100 KCAS, and IGE and OGE hover. The helicopter was headed toward the sun for all temperature measurements. All vents and the pilot and copilot doors and windows were open and the cabin cooling fans were on for in-flight temperature measurements. Static temperatures were recorded with the vents, windows, and doors open and closed. Temperature data for all conditions are presented in table 5. Detailed static temperature data are presented in figures 123 through 126, appenidix G, for locations with a temperature rise of 9°C or greater. Temperature rise was determined by subtracting the outside air temperature from the component temperature of interest.

24. It was found that solar radiation had a significant effect on static temperatures but only a small effect on in-flight temperatures. In-flight data were obtained over a range of solar radiation values by recording data at different times of day from morning until afternoon. Less than 10 minutes were required for in-flight temperatures to stabilize at steady-state values. The in-flight temperature data presented in table 5 were obtained by averaging the temperature data over the range of solar radiation values tested. Static temperatures required about 2 hours to stabilize. This long stabilization time required that temperatures be recorded around noon, when solar radiation was nearly constant, for a 2-hour period. To determine static temperatures for values of solar radiation and ambient air temperature different than those tested an analytical method was developed which is described in appendix F. Figures 123 through 126, appendix G, are the results of this analytical method with representative solar radiation values (refs 9 and 10, app A) also shown.

25. Static temperature data for the cabin and avionics locations are tabulated at a solar radiation value of 350 BTU/hr-ft^2 and outside air temperature of 45°C in table 5. These results show that high temperatures in the forward cabin area occur under static conditions and decrease in flight due to increased air circulation. Temperatures in the engine and transmission areas were low under static conditions but increased in flight due to engine and transmission heat. The high forward cabin static temperatures are due to large amounts of transparent area in the forward

Table 5. Average Temperature Rise.

CH-54B USA S/N 69-18463

Location Number	Location Name	Average Temperature Rise (~ °C)[1]			
		In-Ground-Effect Hover[2]	Out-of-Ground Effect Hover[2]	Level Flight[2]	Static[3]
1	Forward avionics	3.6	3.7	2.6	9.0
2	Instrument panel back	8.2	6.1	6.7	23.0
3	Forward cabin	5.2	5.0	3.7	25.0
4	Aft cabin	4.3	4.0	3.8	11.0
5	Transmission avionics	9.2	8.5	1.9	No data
6	Main rotor tach generator	18.0	6.1	16.5	Zero
7	Gas producer tach generator	17.1	16.5	17.8	Zero
8	Power turbine tach generator	16.7	2.6	1.4	5.0
9	No. 1 hanger bearing	20.0	9.2	16.2	3.0
10	No. 2 hanger bearing	4.9	Zero	17.7	1.0
11	No. 3 hanger bearing	Zero	Zero	15.4	1.0
12	No. 4 hanger bearing	Zero	Zero	13.8	1.0
13	No. 5 hanger bearing	Zero	Zero	11.4	1.0
14	90-degree gearbox	2.8	2.4	Zero	2.0
15	45-degree gearbox	2.6	2.6	9.0	2.0
16	Hydraulic sled	19.2	9.0	16.5	2.0
17	Hoist bay	20.8	27.4	21.9	2.0
[4]18, 19	Main transmission	25.7	17.4	16.4	Zero
20	APP area	17.4	12.2	15.8	Zero

[1]Average temperature rise calculated by subtracting outisde air temperature from each location temperature.
[2]Average solar radiation of 193 BTU/hr-ft^2, windows and vents open.
[3]Data standardized to a solar radiation of 350 BTU/hr-ft^2. Outside air temperature of 45°C. Windows and vents closed.
[4]Average of both locations.

section of the fuselage, which allow solar radiation to enter. The highest average temperature rise recorded was 27.4°C at the hoist bay area during an OGE hover.

Wet Bulb Globe Temperature Index

26. The Wet Bulb Globe Temperature (WBGT) index, as described in reference 11, appendix A, was recorded in flight with all vents and the pilot and copilot doors and windows open and the cockpit cooling fans on. A sensing unit consisting of a dry bulb thermometer, wet bulb thermometer, and black globe thermometer was located near the pilot in the sun. The sensing unit was obtained from the United States Army Medical Equipment Research and Development Laboratory, Fort Totten New York, and is shown in photograph 61, appendix E. Dry bulb and black globe temperatures versus solar radiation and airspeed are presented in figure G.

27. The WBGT index is used to describe the effect of the temperature environment on the human body. It is determined by adding 70 percent of the naturally convected wet bulb temperature, 20 percent of the black globe temperature, and 10 percent of the dry bulb temperature. Temperatures are in degrees Fahrenheit. The following criteria for application of the WBGT index are proposed in Department of the Army Technical Bulletin TB MED 175 (ref 11, app A):

a. When the WBGT Index reaches 82°, discretion should be used in planning heavy exercise for unseasoned personnel.

b. When the WBGT reaches 85°, strenuous exercises, such as marching at standard cadence should be suspended in unseasoned personnel during their first three weeks of training. At this temperature training activities may be continued on a reduced scale after the second week of training.

c. Outdoor classes in the sun should be avoided when the WBGT exceeds 85°.

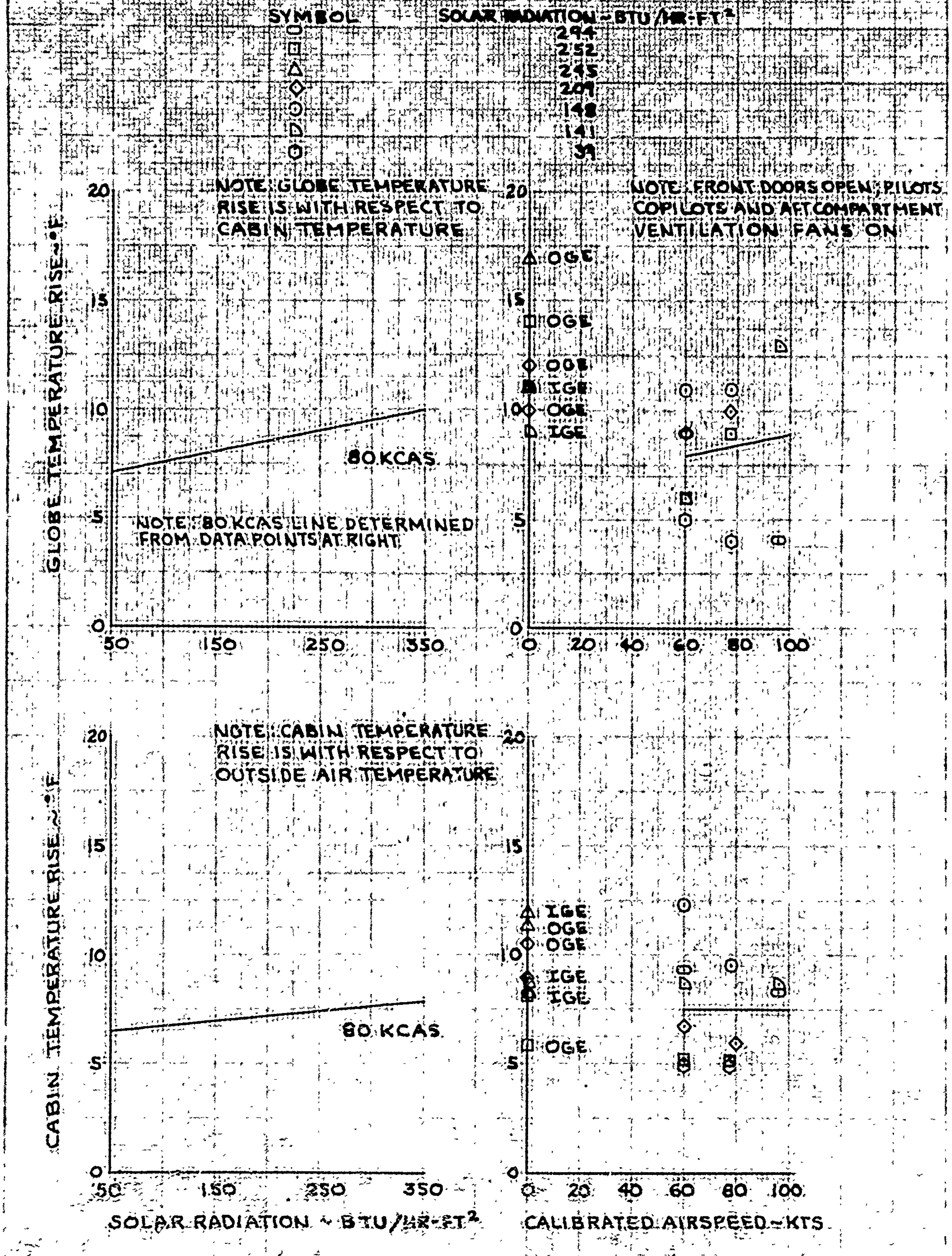
d. When the WBGT reaches 88°, strenuous exercise should be curtailed for all recruits and other trainees with less than 12 weeks training in hot weather. Hardened personnel, after having been acclimatized each season, can carry on limited activity at WBGT of 88° to 90° for periods not exceeding 6 hours a day.

The highest WBGT index value recorded in cruise flight was 74.8°F at an outside air temperature of 88°F, a relative humidity of 41 percent, and a solar radiation value of 245 BTU/hr-ft^2. Based on the data presented in figure G and a psychrometric chart, the WBGT index can be calculated for any combination of outside air temperatures, relative humidity, and solar radiation. For an outside air temperature of 100°F, a relative humidity of 50 percent, and a solar radiation of 250 BTU/hr-ft^2, the WBGT index would be 93.1°F at the pilot station. This

FIGURE G

CABIN AND GLOBE TEMPERATURE AT PILOT STATION

CH-54B USA S/N 69-18463



calculation is described in appendix F. A WBGT index of 93.1°F is well in excess of the maximum discussed in the above criteria, and it is likely that a WBGT index higher than 93.1°F would be recorded under certain conditions. Excessively high WBGT index at the pilot station under certain environmental conditions is a shortcoming.

CONCLUSIONS

GENERAL

28. Analysis of the test results obtained during this evaluation resulted in the following conclusions:

a. The CH-54B instrument and avionics vibrations are primarily sinusoidal with a random variation of amplitude with time at each discrete frequency (para 14).

b. The primary forward fuselage instrument and avionics vibration source is the main rotor with a maximum mean plus 3-sigma acceleration of 0.41g at the main rotor 6/rev frequency of 18.5 Hz (para 14).

c. The primary aft fuselage avionics vibration sources are gearboxes, shafts, and other rotating components with a maximum mean plus 3-sigma acceleration of 4.0g at 55.5 Hz (para 14).

d. All instrument and avionics mean plus 3-sigma vibration levels are below the laboratory test curve of MIL-STD-810B (para 15).

e. The pilot seat pad did not attenuate main rotor-induced vibrations (para 18).

f. The pilot's body attenuated vibrations above 10 Hz (para 19).

g. The maximum mean plus 3-sigma vibration level for all locations tested was 117g at 1915 Hz at the auxiliary power plant (para 21).

h. The CH-54B main rotor-induced vibrations showed less main rotor harmonic frequency content and their levels were lower than those of the OH-58A and UH-1H helicopters (para 22).

i. The highest instrument and avionics temperatures were recorded in the cabin area under static conditions and decreased in forward flight (para 25).

j. The highest average temperature rise was 27.4°C above the outside air temperature at the hoist bay in an OGE hover (para 25).

k. There were no deficiencies and two shortcomings noted during the testing.

SHORTCOMINGS AFFECTING MISSION ACCOMPLISHMENT

29. Correction of the following shortcomings is desirable for improved operation and mission capabilities:

a. Amplification of vibrations at the main rotor driving frequencies by the vibration isolation mounts on the CN-998/ASN-43 directional gyro and RT-742/ARC-51BX radio (para 16).

b. Excessively high Wet Bulb Globe Temperature index at the pilot station under certain environmental conditions (para 27).

RECOMMENDATIONS

30. The shortcomings should be corrected.

31. The data in this report and subsequent environmental test reports should be applied to revising appropriate military environmental specifications.

32. Improved vibration isolation for instrument and avionics components should be provided (para 16).

APPENDIX A. REFERENCES

1. Letter, AVSCOM, AMSAV-EF, 31 August 1971, subject: AVSCOM Test Request No. 70-15, Instrument Panel, Avionics Compartment and Crew Station Environmental Study.

2. Final Report, USAASTA, Project No. 70-15-1, *Instrument Panel and Avionics Compartment Environmental Survey, Production OH-58A Helicopter*, September 1972.

3. Final Report, USAASTA, Project No. 70-15-2, *Vibration and Temperature Survey, Production UH-1H Helicopter*, January 1973.

4. Technical Manual, TM 55-1520-217-10/2, *Army Model CH-54B Helicopter*, 13 March 1972.

5. Test Plan, USAASTA, Project No. 70-15, *Helicopter Vibration and Environmental Survey*, July 1971.

6. Military Standard, MIL-STD-810B, *Environmental Test Methods*, 15 June 1967.

7. Military Specification, MIL-H-8501A, *Helicopter Flying and Ground Handling Qualities; General Requirements For*, 7 September 1961, amended 3 April 1962.

8. Test Data Reduction Report, NORT 73-203, Northrop Corporation Electronics Division, *Environmental Vibration Survey, CH-54B Helicopter-Tarhe*. February 1973.

9. Publication, Instut Royale Meteorologique de Belgique, *Donnes du Rayonnement Solair a Leopoldville*, Periode 1953-1962, 1965.

10. Publication, D2-90577-2, R.A. Atlas and B. N. Charles, *Summary of Solar Radiation Characteristics, Tabular Summaries*, December 1964.

11. Department of the Army Technical Bulletin, TB MED 175, *The Etiology, Prevention, Diagnosis, and Treatment of Adverse Effects of Heat*, 25 April 1969.

APPENDIX B. AIRCRAFT INFORMATION

DIMENSIONS AND DESIGN DATA

Overall Dimensions

Aircraft length (rotor turning)	88 ft, 6 in.
Height (to top of turning tail rotor)	25 ft, 4 in.

Main Rotor

Number of blades	6
Diameter	72.236 ft
Blade chord (constant)	26.0 in.
Solidity	0.1146
Blade twist (nonlinear)	-10.65 deg
Airfoil type	NACA 0011 modified

Tail Rotor

Number of blades	4
Diameter	16.0 ft
Blade chord (constant)	15.4 in.
Blade twist	Zero
Airfoil type	NACA 0012

Gear Ratios

Engine to main rotor	48.5437:1
Engine to tail rotor	10.5932:1

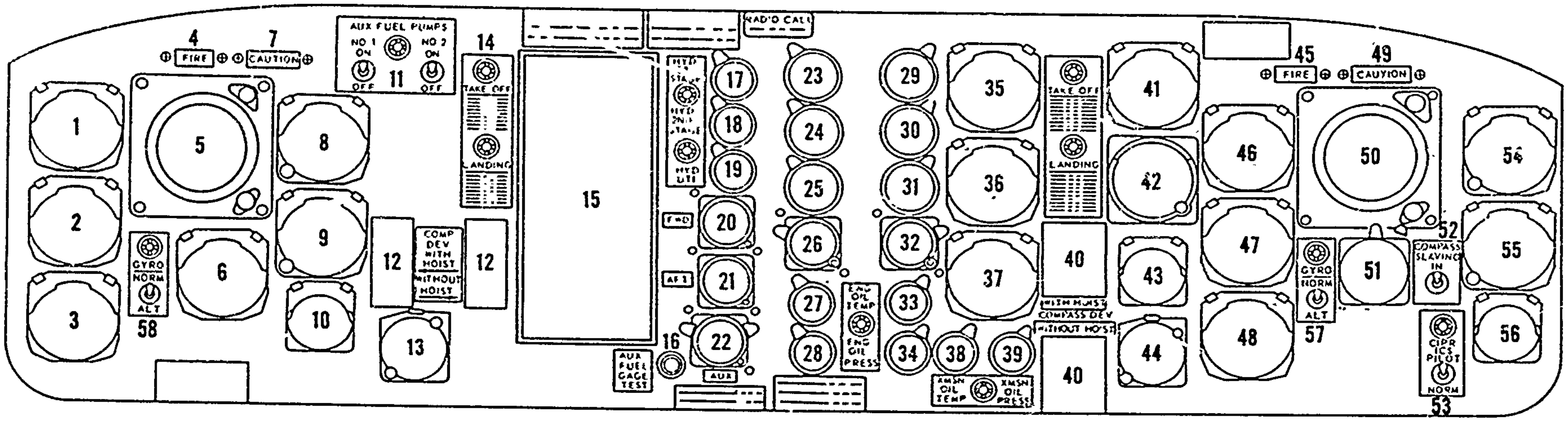
Operating Limitations

Engine power (30 minutes)	4800 shp
Engine power (continuous)	4430 shp
Rotor speed (power ON)	100 to 104 percent
Rotor speed (power OFF)	90 to 110 percent
Maximum airspeed (sea level)	105 knots
Maximum gross weight	47,000 lb
Maximum fuel	8775 lb

Transmission Ratings

Dual-engine operation:	
30 minutes	7900 shp (82.3 percent Q)
Maximum continuous	6600 shp (68.8 percent Q)
Single-engine operation:	
30 minutes	4800 shp (100 percent Q)
Maximum continuous	3300 shp (68.8 percent Q)

Instrument Panel Configuration, CH-54B S/N 69-18463



1. COPILOT'S AIRSPEED INDICATOR
2. COPILOT'S TORQUEMETER
3. COPILOT'S TRIPLE TACHOMETER
4. COPILOT'S FIRE WARNING LIGHT
5. COPILOT'S ATTITUDE INDICATOR
6. COPILOT'S RADIO MAGNETIC INDICATOR
7. COPILOT'S MASTER CAUTION LIGHT
8. COPILOT'S ALTIMETER
9. COPILOT'S VERTICAL VELOCITY INDICATOR
10. COPILOT'S TURN AND SLIP INDICATOR
11. NO.1 AND NO.2 AUX FUEL PUMPS, SWITCHES
12. COMPASS CORRECTION CARDS
13. COPILOT'S CLOCK
14. COPILOT'S CHECKLIST IDENTIFICATION
15. CAUTION ADVISORY PANEL
16. AUXILIARY FUEL GAGE TEST BUTTON
17. 1st STAGE HYDRAULIC INDICATOR
18. 2nd STAGE HYDRAULIC INDICATOR
19. UTILITY HYDRAULIC PRESSURE INDICATOR
20. FUEL QUANTITY INDICATOR (FWD)
21. FUEL QUANTITY INDICATOR (AFT)
22. FUEL QUANTITY INDICATOR (AUX)
23. NO.1 ENGINE GAS GENERATOR TACHOMETER
24. NO 1 ENGINE POWER TURBINE INLET TEMPERATURE INDICATOR
25. NO.1 ENGINE FUEL FLOW INDICATOR
26. NO.1 ENGINE PRESSURE RATIO INDICATOR
27. NO.1 ENGINE OIL TEMPERATURE INDICATOR
28. NO 1 ENGINE OIL PRESSURE INDICATOR
29. NO 2 ENGINE GAS GENERATOR TACHOMETER
30. NO.2 ENGINE POWER TURBINE INLET TEMPERATURE INDICATOR
31. NO 2 ENGINE FUEL FLOW INDICATOR
32. NO 2 ENGINE PRESSURE RATIO INDICATOR
33. NO.2 ENGINE OIL TEMPERATURE INDICATOR
34. NO 2 ENGINE OIL PRESSURE INDICATOR
35. CARGO HOIST CABLE LENGTH INDICATOR
36. WINCH (CARGO HOIST) TENSION INDICATOR
37. FLIGHT DIRECTOR INDICATOR
38. TRANSMISSION OIL TEMPERATURE INDICATOR
39. TRANSMISSION OIL PRESSURE INDICATOR
40. COMPASS CORRECTION CARDS
41. PERFORMANCE INDICATOR
42. COURSE INDICATOR
43. WINCH (CARGO HOIST) HYDRAULIC TEMPERATURE INDICATOR
44. PILOT'S CLOCK
45. PILOT'S FIRE WARNING LIGHT
46. PILOT'S AIRSPEED INDICATOR
47. PILOT'S TORQUEMETER
48. PILOT'S TRIPLE TACHOMETER
49. PILOT'S MASTER CAUTION LIGHT
50. PILOT'S ATTITUDE INDICATOR
51. PILOT'S RADIO MAGNETIC INDICATOR
52. COMPASS SLAVING SWITCH
53. PILOT'S CIPR ICS SWITCH
54. PILOT'S ALTIMETER
55. PILOT'S VERTICAL VELOCITY INDICATOR
56. PILOT'S TURN AND SLIP INDICATOR
57. PILOT'S GYRO SELECTOR SWITCH.
58. COPILOT'S GYRO SELECTOR SWITCH.

APPENDIX C. CONFIGURATIONS

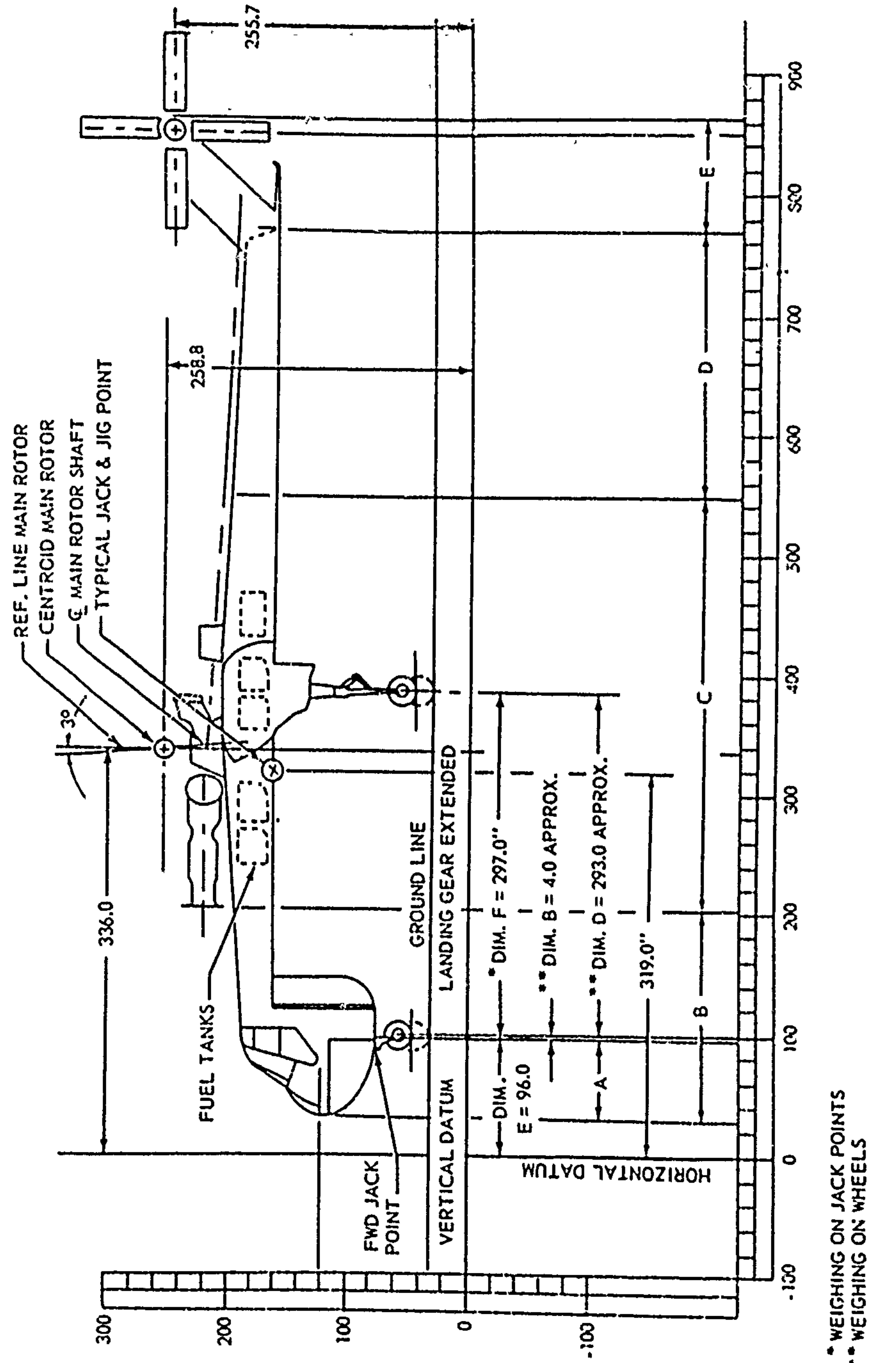


FIGURE 1. HELICOPTER DIAGRAM

Table 1. Clean Test Configuration.

Item	Weight (lb)	Longitudinal Fuselage Station (in.)	Lateral Fuselage Station (in.)	Longitudinal Moment (in.-lb)	Lateral Moment (in.-lb)
Basic aircraft	21,986	337.0	-1.13	7,409,219	-24,945
Average fuel	5,664	359.86	Zero	2,038,226	Zero
Instrumentation	150	110	-35	16,500	-3,850
Pilot	225	94	+20	21,150	4,500
Copilot	225	94	-20	21,150	-4,500
Engineer	150	108.5	Zero	16,275	Zero
Test conditions	28,400	335.3 (mid)	-1.0, left	9,522,520	-28,795

Table 2. Sling Load Test Configuration.

Item	Weight (lb)	Longitudinal Fuselage Station (in.)	Lateral Fuselage Station (in.)	Longitudinal Moment (in.-lb)	Lateral Moment (in.-lb)
Basic aircraft	21,986	337.0	-1.13	7,409,219	-24,945
Average fuel	5,889	361.69	Zero	2,129,971	Zero
Instrumentation	150	110	-35	16,500	-3,850
Pilot	225	94	+20	21,150	4,500
Copilot	225	94	-20	21,150	-4,500
Engineer	150	108.5	Zero	16,275	Zero
Crew chief	175	127	+30	22,225	5,250
Sling load[1]	13,100	333	Zero	4,362,300	Zero
Test conditions	41,900	334.1 (mid)	-0.6, left	13,998,790	-23,545

[1]The sling load was an engine can, ballasted with concrete, with dimensions as shown:

Table 3. Pod Test Configuration.

Item	Weight (lb)	Longitudinal Fuselage Station (in.)	Lateral Fuselage Station (in.)	Longitudinal Moment (in.-lb)	Lateral Moment (in.-lb)
Basic aircraft	21,986	337.0	-1.13	7,409,226	-24,945
Average fuel	5,883	361.60	Zero	2,127,292	Zero
Instrumentation	150	110	-35	16,500	-3,850
Pilot	225	94	+20	21,150	4,500
Copilot	225	94	-20	21,150	-4,500
Engineer	150	108.5	Zero	16,275	Zero
Pod (empty)	2,881	316.3	Zero	911,260	Zero
Ballast[1]	10,400	330.0	Zero	3,432,000	Zero
Test conditions	41,900	333.1 (mid)	-0.7 (mid)	13,954,853	-28,795

[1]Pod ballast evenly distributed at longitudinal stations 290, 330, and 370.

APPENDIX D. TEST INSTRUMENTATION

GENERAL

1. Flight test instrumentation was installed, calibrated, and maintained by the Instrumentation and Calibration Divisions of USAASTA and USAAMRDL. This instrumentation was used to record vibration data, temperature data, and flight condition parameters. A list of the instrumentation components is presented in table 1.

VIBRATION INSTRUMENTATION

2. An FM-FM magnetic tape system was used to record the vibration data. A block diagram of the instrumentation system is presented in figure 1. Data were recorded over a frequency range of 2 to 2000 Hz for all flight conditions. The transducers were miniature triaxial, biaxial, and uniaxial piezoelectric accelerometers which were mounted at 70 locations throughout the aircraft for a total of 182 channels of vibration data. The instrumentation was limited to recording data from 12 accelerometers simultaneously. To record more than 12 channels of data, an eight-position manual switching network was employed and each flight condition was recorded for each switch position, for a maximum data capacity of 96 channels. To obtain the total of 182 channels of vibration data, the accelerometers were relocated after completion of all test conditions and the test conditions were repeated. The maximum capacity of the instrumentation system is 96 channels without accelerometer relocation and 192 channels with one relocation. Accelerometers were bonded to the component of interest with the accelerometer axis aligned to the component axis. The mounting locations of each accelerometer are shown in the photographs in appendix E. Table 2 lists the accelerometer locations, accelerometer type, and amplitude range.

3. The vibration instrumentation was calibrated to determine the amplitude sensitivity and frequency response of the total data system. A frequency sweep was performed on each accelerometer with an electrodynamic shaker. Each accelerometer was mounted back to back with a calibrated reference accelerometer and the charge sensitivity, picocoulomb/g, and frequency response of the test accelerometer determined by comparison with the reference accelerometer. The airborne data recording system was calibrated by means of a charge source. For each channel, the charge source was set to simulate a given acceleration value by reference to the accelerometer charge sensitivity determined by the shaker calibration, and the airborne data system output was recorded. The ground station was calibrated separately from the airborne system, and the two system scale factors were combined to obtain an overall data system scale factor. It is estimated that the accuracy of the total vibration measurement system, both airborne and ground units, is within ±10 percent of the true acceleration amplitude.

Table 1. Instrumentation Component Description.

Nomenclature	Manufacturer	Quantity	Model Number
Piezoelectric accelerometer (triaxial)	Endevco	32	2228C
Piezoelectric accelerometer (uniaxial)	Endevco	8	2226C
Line driver	MB Electronics	81	9402216
Amplifier	MB Electronics	12	N400
Switching relays	Potter and Brumfield	24	JDT27DD1
FM rack	Electro Mechanical Research	2	--
FM rack voltage code oscillator (VCO)	Electro Mechanical Research	12	307A-02
FM rack mixing amplifier	Electro Mechanical Research	2	311A-02-1
FM rack reference oscillator	Electro Mechanical Research	2	313A-01
Tape recorder	Genisco Technology Corp.	1	10-286
Time code generator	Electro Mechanical Research	1	CL24D-27.6A
Thermocouple switch (24 channels)	Thermo Electric	1	33113
Thermocouple indicator	Newport Laboratories	1	2600
Thermocouple wire (iron-constantan)	Series J	--	--
Thermal radiometer	Teledyne Geotech	1	TCH-188-01

FIGURE 1
AIRBORNE DATA SYSTEM

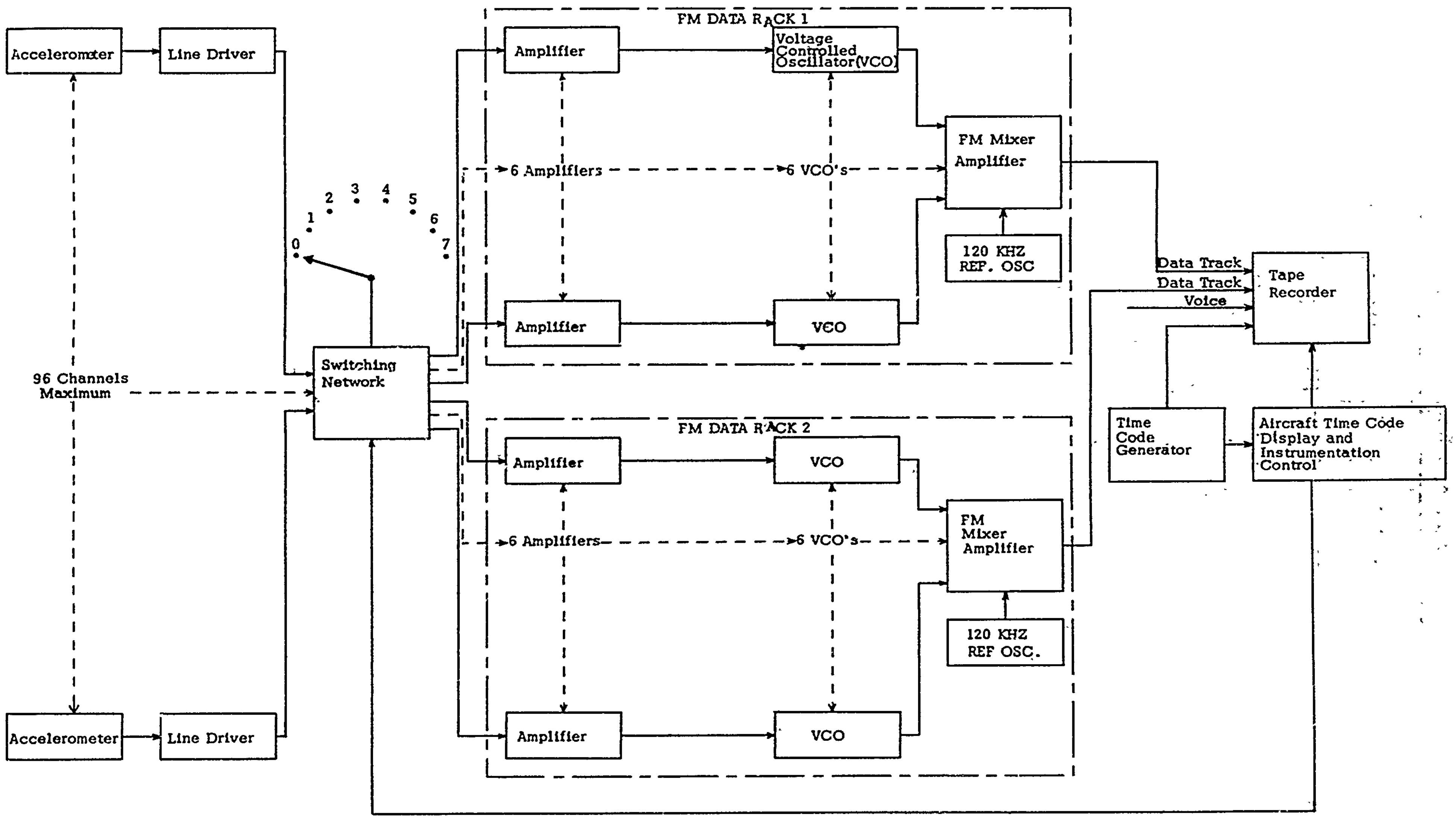


Table 2. Accelerometer Locations.

Location	Location Number	Fuselage Station (in.)	Water Line (in.)	Buttline (in.)	Axis	Full Scale Acceleration Range (± g)	Accelerometer Type[1]
Instrument panel	1	62.0	145.5	20.5L	3	5	2228C
	2	65.0	140.0	17.5L	3	5	2228C
	3	65.0	140.0	6.5L	3	5	2228C
	4	64.0	141.0	Zero	3	5	2228C
	5	65.0	140.0	10.0R	3	5	2228C
	6	62.0	145.5	21.0R	3	5	2228C
	7	67.5	136.0	21.0R	3	5	2228C
Avionics							
CN-998/ASN-43 directional gyro mount	8	56.0	120.0	8.0R	3	5	2228C
CN-998/ASN-43 directional gyro	9	56.0	122.0	8.0R	3	5	2228C
RT-742/ARC-51BX radio mount	10	84.0	101.0	42.5R	3	5	2228C
RT-742/ARC-51BX radio	11	84.0	103.0	42.5R	3	5	2228C
R-1388/ARN-82 radio	12	84.0	88.0	41.5R	3	5	2228C
AFCS amplifier	13	57.5	90.0	Zero	3	5	2228C
AFCS transducer package	14	338.0	182.5	33.0R	3	5	2228C
Pilot							
Seat pad plate	15	90.0	124.0	20.5R	3	5	2228C
Seat structure	16	90.0	129.5	20.5R	3	5	2228C
Right pedal foot rest	17	70.5	121.0	29.0R	Vertical, lateral	5	2228C
Collective grip	18	82.5	140.0	10.0R	Vertical	5	2226C
Cyclic grip	19	77.0	146.0	20.5R	3	5	2228C
Pilot's helmet (SPH-4)	20	--	--	--	3	5	2228C
Bite block	21	--	--	--	3	5	2228C
Main rotor tach generator	22	359.0	202.0	4.5L	3	100	2228C
Power turbine tach generator	23	243.5	214.5	35.5L	3	50	2228C
Gas producer tach generator	24	294.5	230.5	11.0L	3	50	2228C
Transmission mounts							
Forward	25	319.0	166.0	Zero	3	50	2228C
Aft	26	319.0	167.5	Zero	3	50	2228C
Right	27	339.5	167.0	20.5R	3	50	2228C
Left	28	339.5	167.0	20.5L	3	50	2228C
Upper main transmission	29	339.5	235.0	4.0R	3	50	2228C
Tail rotor shaft 90-degree gearbox	30	872.0	256.0	5.0L	3	50	2228C
Tail rotor shaft 45-degree gearbox	31	802.0	187.0	Zero	3	100	2228C
Tail rotor shaft hanger bearing							
No. 1	32	435.5	210.0	4.0R	Vertical, lateral	50	2228C
No. 2	33	511.0	205.0	4.0R	Vertical, lateral	50	2228C
No. 3	34	589.0	200.0	4.0R	Vertical, lateral	50	2228C
No. 4	35	649.0	194.5	4.0R	Vertical, lateral	50	2228C
No. 5	36	729.0	187.5	4.0R	Vertical, lateral	50	2228C

Hydraulic pump, 1st stage	37	357.0	227.0	3.5R	3	50	2228C
Hydraulic line, hoist power	38	327.5	203.1	43.0R	3	50	2228C
Hydraulic manifold, 2nd stage	39	330.0	206.5	43.0R	3	5	2228C
Hydraulic pump, utility	40	362.5	219.0	11.0R	3	300	2228C
Hydraulic sled	41	435.5	203.5	8.0L	3	50	2228C
Oil cooler support	42	368.5	228.0	8.0R	3	167	2228C
Oil cooler idler	43	363.0	232.5	Zero	3	167	2228C
APP fuel pressure switch	44	384.0	219.0	6.0R	3	17	2228C
Engine fuel pressure switch	45	267.0	196.0	13.0L	3	5	2228C
Brake cylinder, rudder pedal	46	67.5	113.0	29.0R	3	5	2228C
Rotor brake support	47	338.0	219.5	40.5L	3	50	2228C
Compass transmitter support	48	619.0	162.0	Zero	3	5	2228C
Pilot cooling fan	49	56.5	123.0	30.0R	3	5	2228C
Horizontal stabilizer tip	50	847.0	267.0	106.0R	3	17	2228C
Anticollision light, nose	51	68.5	77.0	Zero	3	5	2228C
Primary servo actuator							
No. 1	52	327.5	237.0	8.0R	3	50	2228C
No. 2	53	347.5	237.0	8.0R	3	50	2228C
AFCS servo	54	112.0	141.5	30.0R	3	5	2228C
Hydraulic manifold, 1st stage	55	409.5	217.8	27.0L	3	50	2228C
ADF antenna mount	56	609.5	205.5	Zero	3	5	2228C
APP clutch	57	385.0	209.0	9.5R	3	300	2228C
APP mount	58	381.5	201.0	9.5R	3	50	2228C
Engine							
Torque tube top	60	325.5	221.2	27.0L	Vertical	50	2226C
Torque tube side	60	325.5	213.8	24.0L	Lateral	50	2226C
Outboard absorber	61	295.6	211.0	41.0L	Vertical, lateral	50	2228C
Inboard absorber	62	295.6	211.0	11.0L	Vertical, lateral	50	2228C
Outboard forward mount	63	248.0	215.0	34.5L	Vertical, lateral	50	2228C
Inboard forward mount	64	248.0	215.0	16.5L	Vertical, lateral	50	2228C
Engine							
Power turbine top	65	227.0	226.0	27.0L	Vertical	50	2226C
Power turbine side	66	227.0	213.8	23.5L	Lateral	50	2226C
Rear frame top	67	251.0	228.0	27.0L	Vertical	50	2226C
Rear frame side	68	251.0	213.8	15.0L	Lateral	50	2226C
Front frame top	69	223.5	227.0	27.0L	Vertical	50	2226C
Front frame side	70	223.5	213.8	23.0L	Lateral	50	2226C

[1]2228C accelerometers are triaxial, 2226C accelerometers are uniaxial accelerometers.

TEMPERATURE INSTRUMENTATION

4. Temperature data were recorded by mounting thermocouples at 20 locations throughout the helicopter. The temperatures were displayed on one temperature indicator which was switched to the desired thermocouple. Table 3 lists the locations of the thermocouples and the temperature measurement equipment is described in table 1. Photographs of the thermocouple locations are presented in appendix E. Solar radiation was recorded on the ground with a calibrated radiometer. Outside air temperature (OAT) was recorded with a laboratory thermometer for static temperature measurements and with the ship's OAT indicator for in-flight temperature measurement.

FLIGHT CONDITION PARAMETERS

5. The parameters listed in table 4 were hand-recorded from the ship's standard instruments to determine the flight condition. An estimate of the readability of each instrument is also given in table 4.

Table 3. Thermocouple Locations.

Location	Location Number	Fuselage Station (in.)	Water Line (in.)	Buttline (in.)
Forward avionics	1	62.5	95.0	4.5R
Instrument panel back	2	62.0	140.5	Zero
Forward cabin	3	103.8	180.5	Zero
Aft cabin	4	138.6	109.0	39.5L
Transmission avionics	5	338.0	185.5	38.0R
Main rotor tach generator	6	359.0	202.0	4.5L
Gas producer tach generator	7	294.5	230.5	11.0L
Power turbine tach generator	8	243.5	214.5	35.5L
Hanger bearing No. 1	9	435.5	210.0	Zero
Hanger bearing No. 2	10	511.0	205.0	Zero
Hanger bearing No. 3	11	589.0	200.0	Zero
Hanger bearing No. 4	12	649.0	194.5	Zero
Hanger bearing No. 5	13	729.0	197.5	Zero
90-degree gearbox	14	872.0	256.0	5.0L
45-degree gearbox	15	802.0	187.0	Zero
Hydraulic sled	16	424.0	212.0	21.5L
Hoist bay	17	324.0	194.5	Zero
Main transmission	18, 19	339.5	167.0	20.5R, L
APP area	20	384.0	219.0	6.0R

Table 4. Flight Condition Parameters.

Parameter	Range of Interest	Readability
Airspeed	20 to 105 knots	±1 knot
Altitude	Zero to 10,000 feet	±4 feet
Outside air temperature	Zero to 30°C	±0.4°C
Main rotor speed	95 to 105 percent	±1 percent
Gas producer speed	37 to 104.2 percent	±0.2 percent
Fuel quantity	Zero to 8817 pounds	±20 pounds

APPENDIX E. INSTRUMENTATION PHOTOGRAPHS

Index

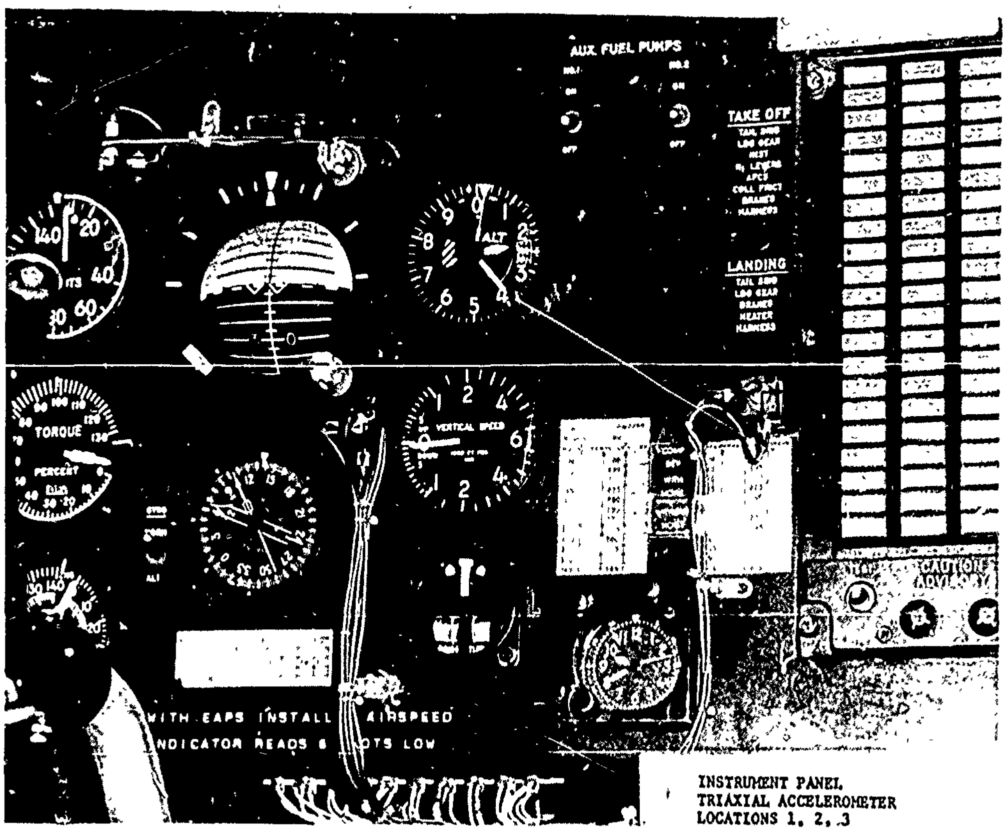


Photo 1.

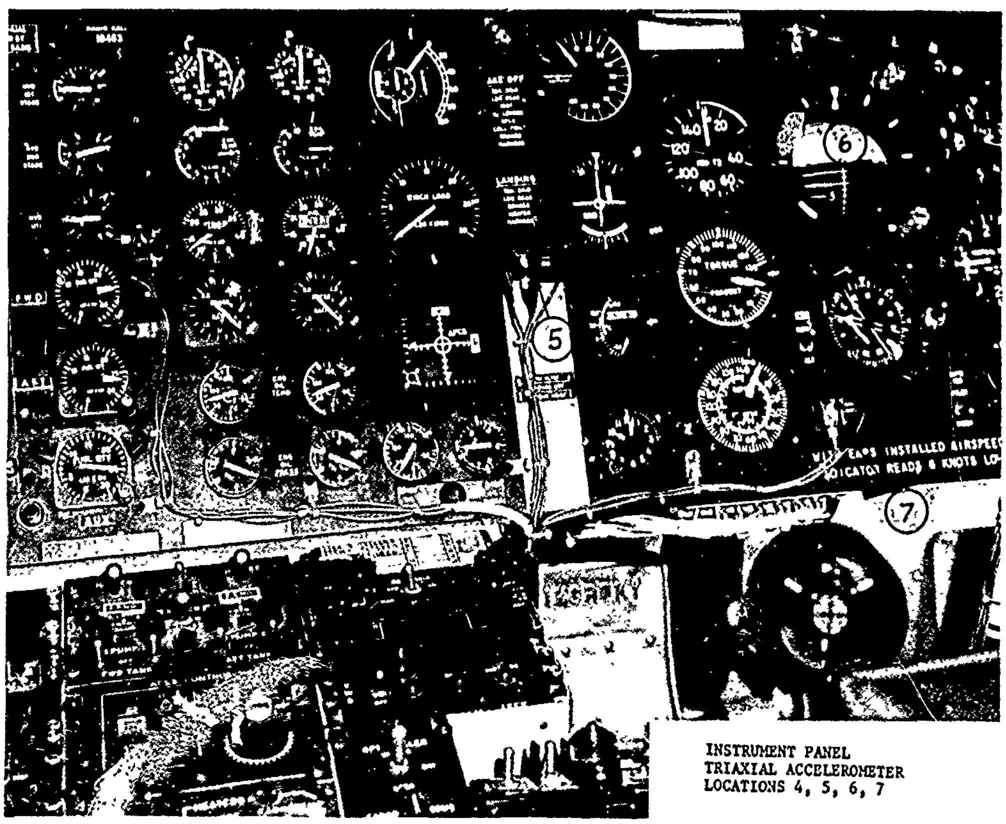
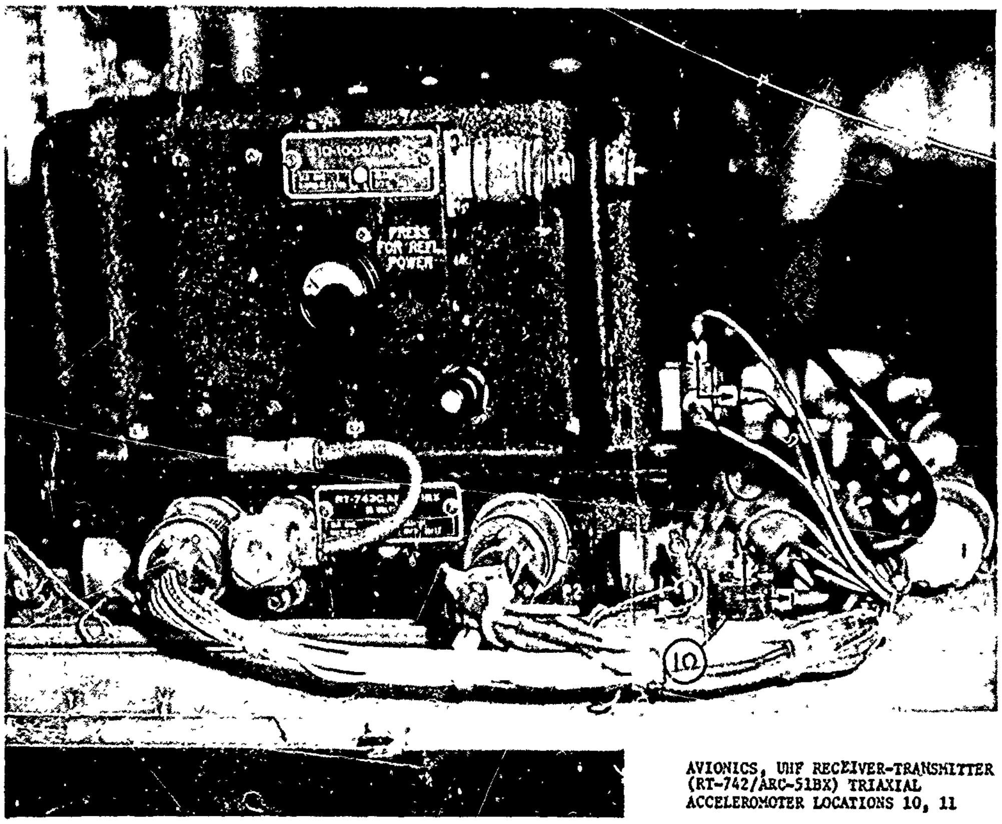


Photo 2.

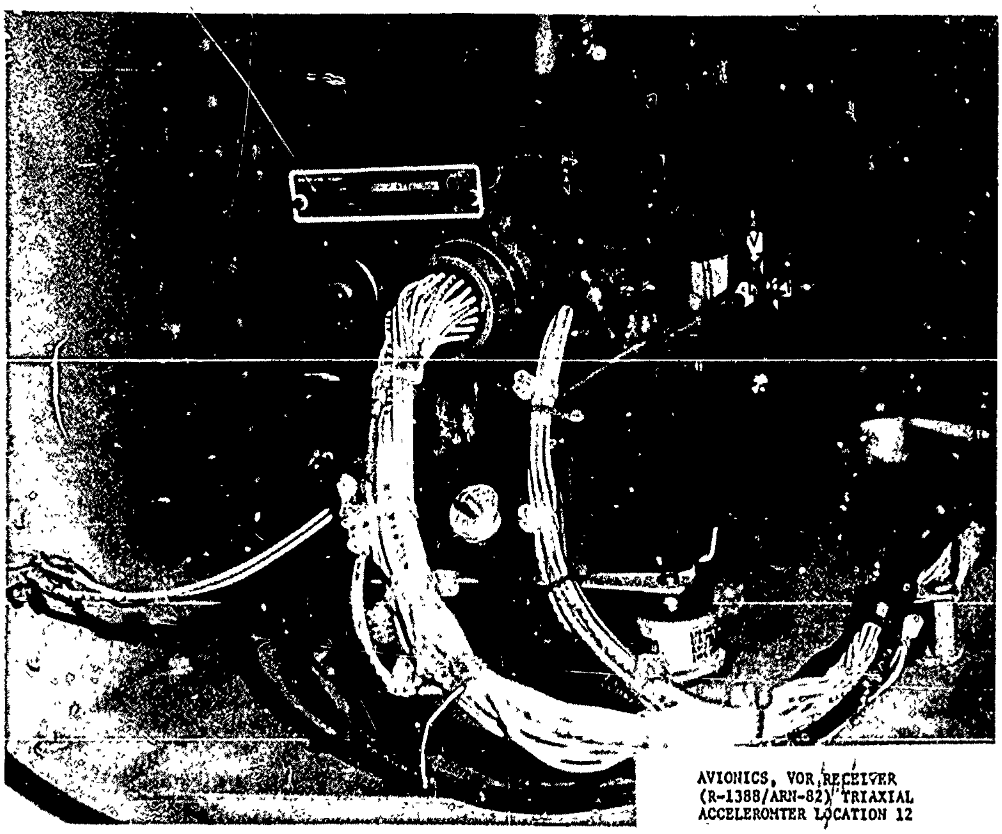
AVIONICS, DIRECTIONAL GYRO (CN-998/ASN-43) TRIAXIAL ACCELEROMETER LOCATIONS 8, 9

Photo 3.



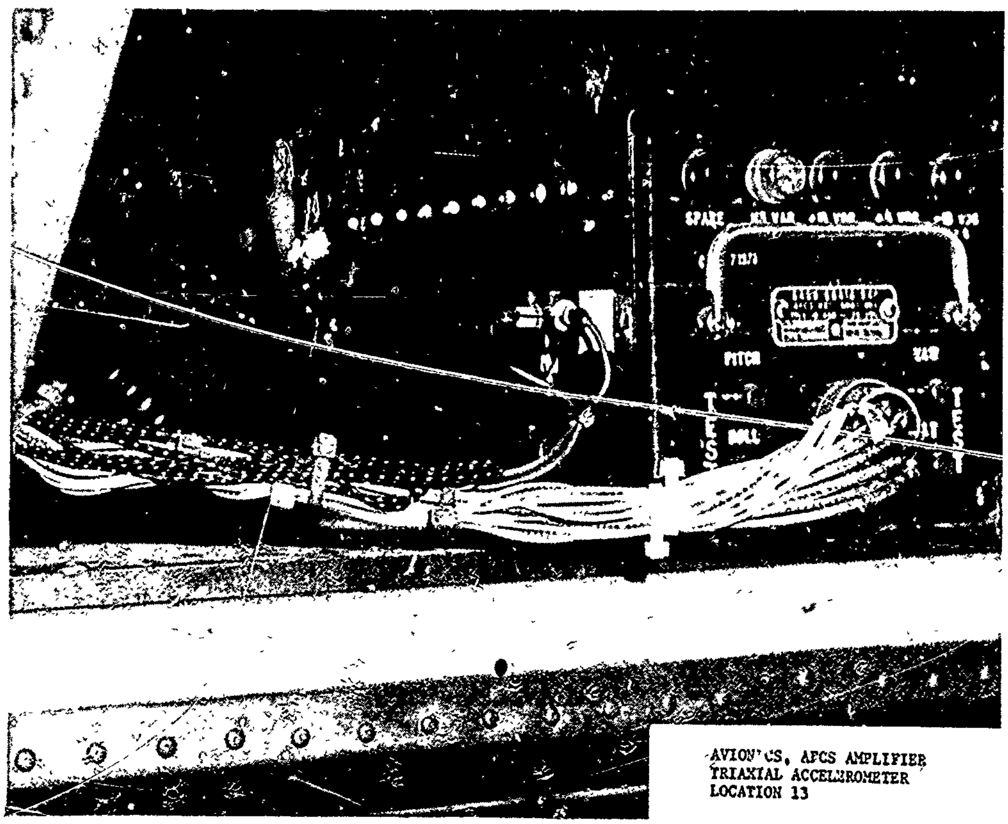
AVIONICS, UHF RECEIVER-TRANSMITTER (RT-742/ARC-51BX) TRIAXIAL ACCELEROMOTER LOCATIONS 10, 11

Photo 4.



AVIONICS, VOR RECEIVER
(R-1388/ARN-82) TRIAXIAL
ACCELEROMTER LOCATION 12

Photo 5.



AVIONICS, AFCS AMPLIFIER
TRIAXIAL ACCELEROMETER
LOCATION 13

Photo 6.

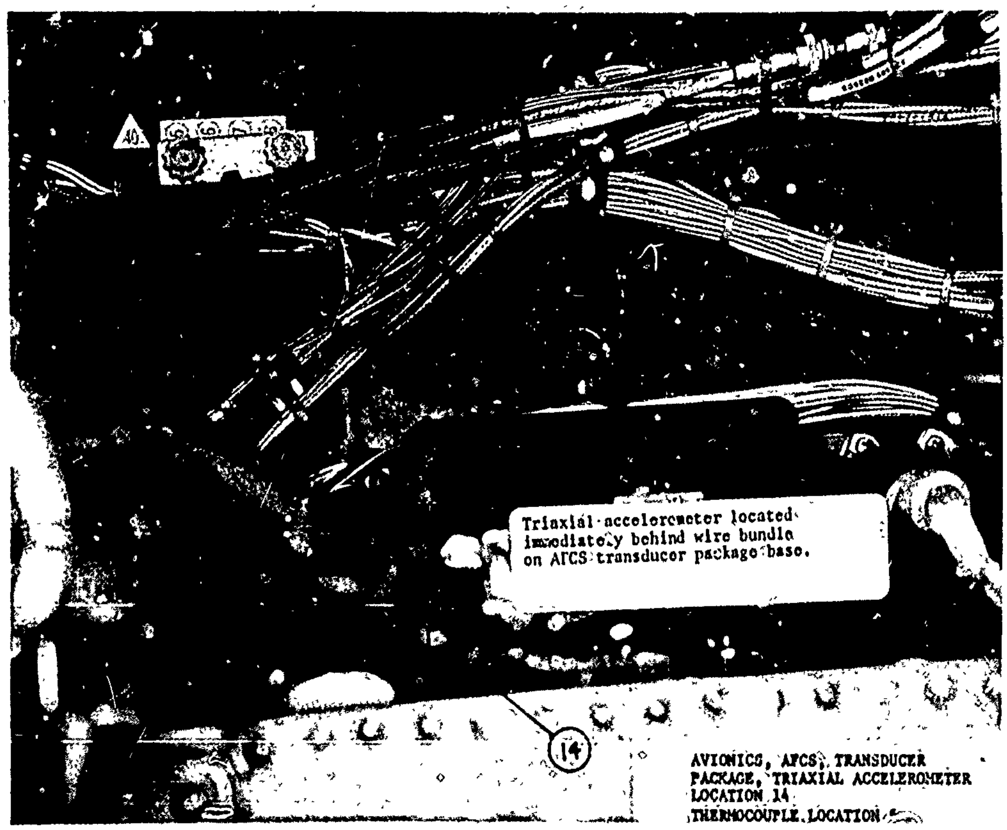


Photo 7.

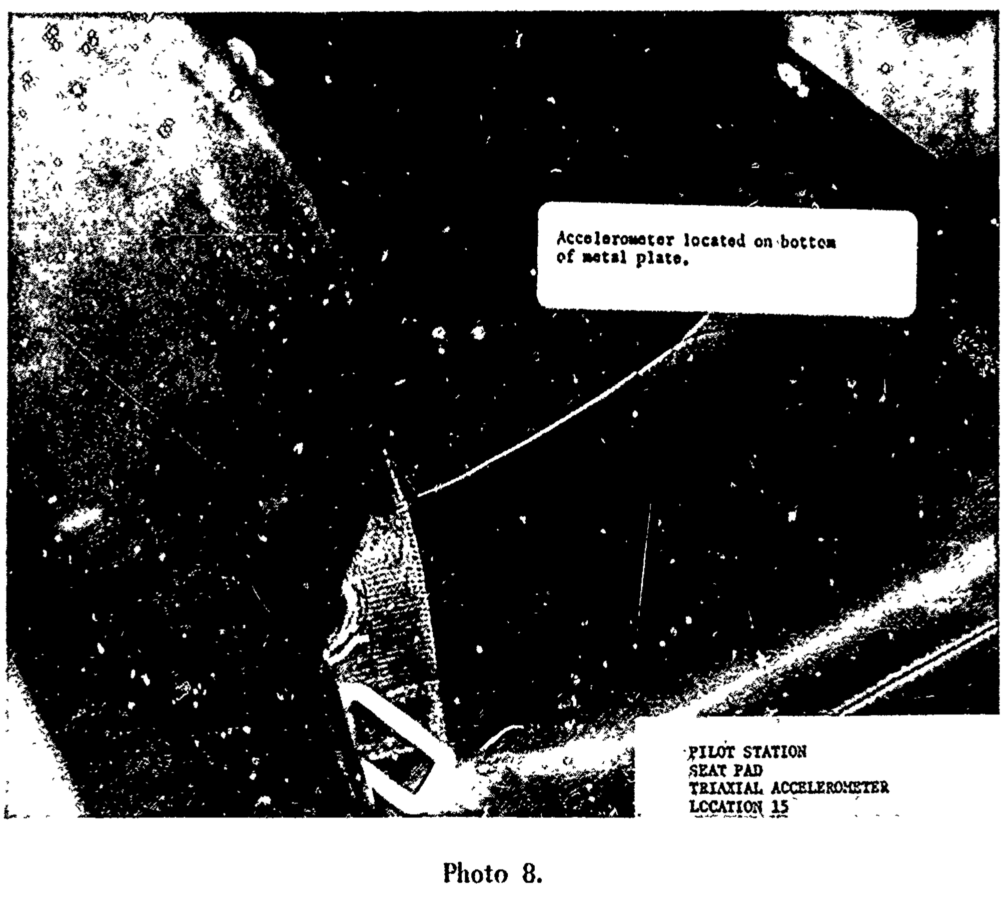


Photo 8.

Photo 9.

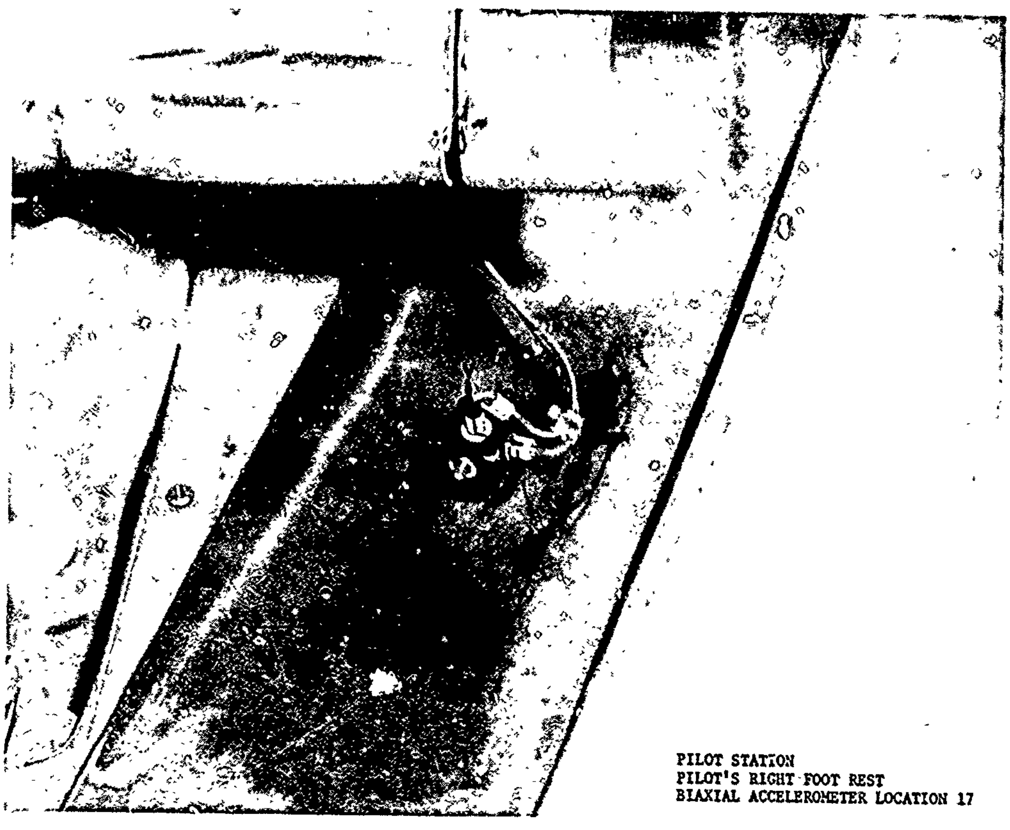


Photo 10.

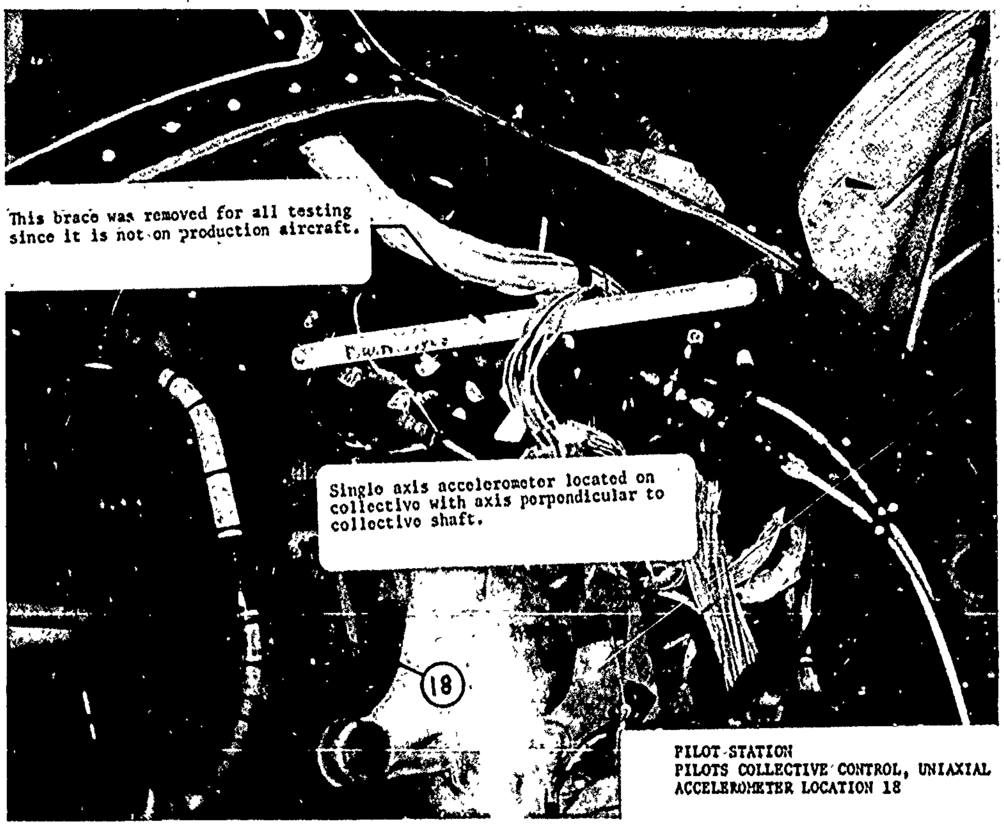


Photo 11.

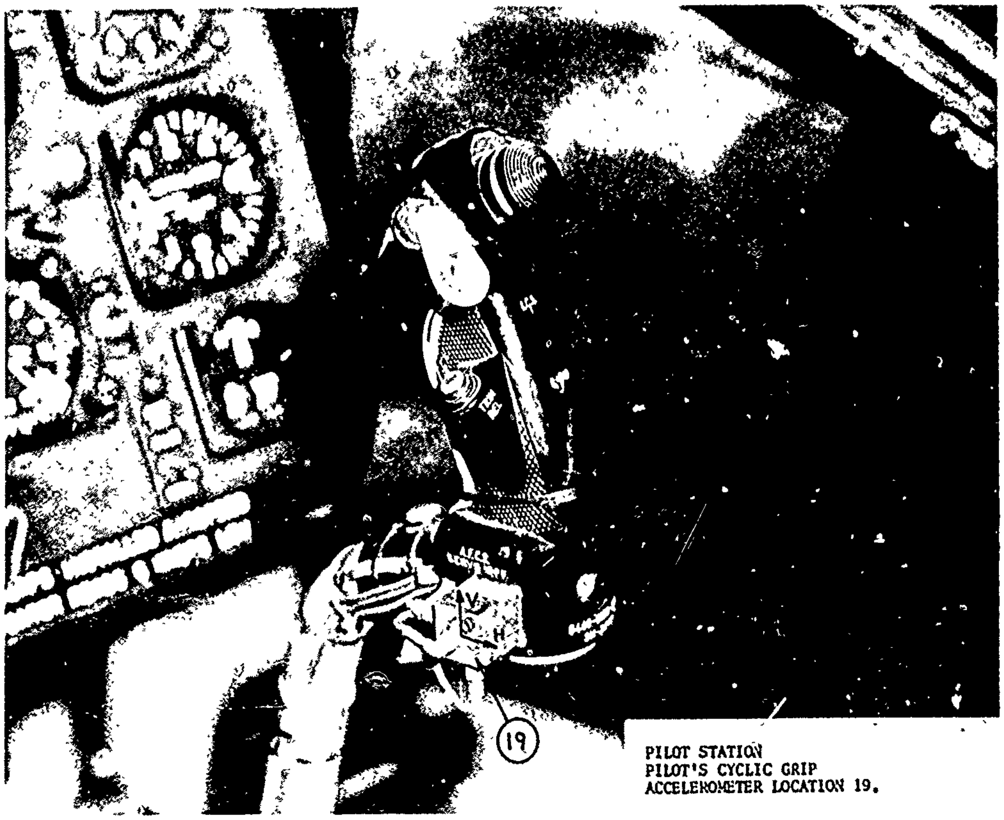
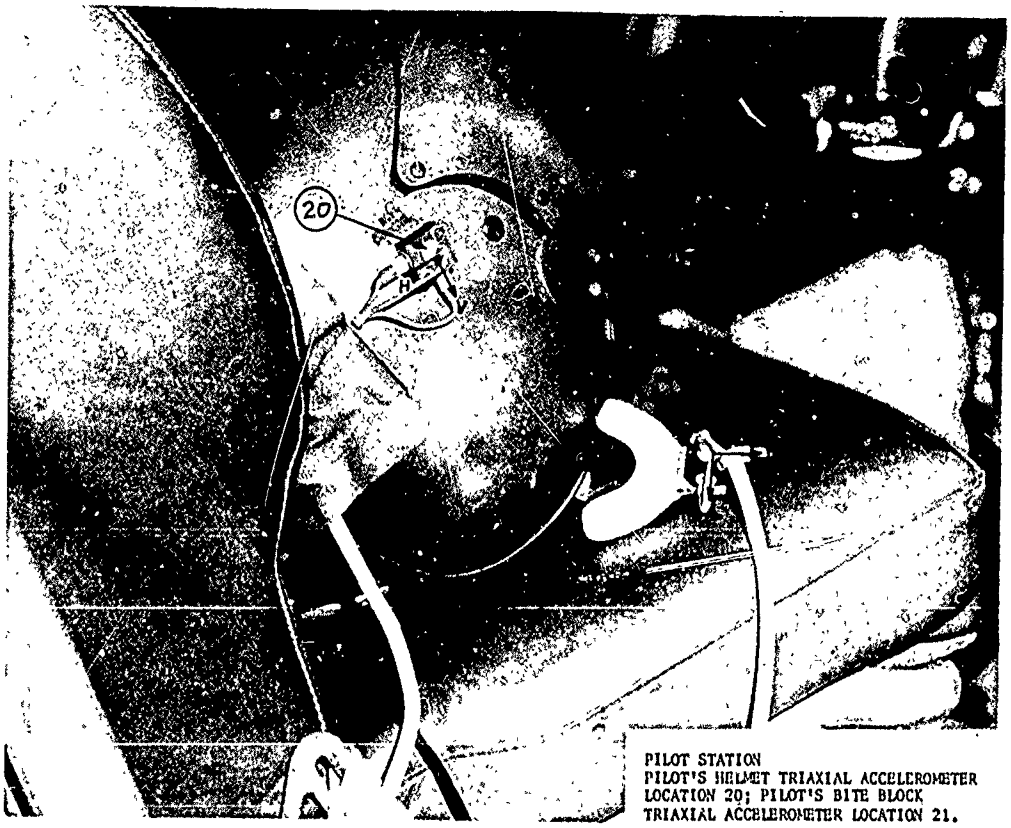
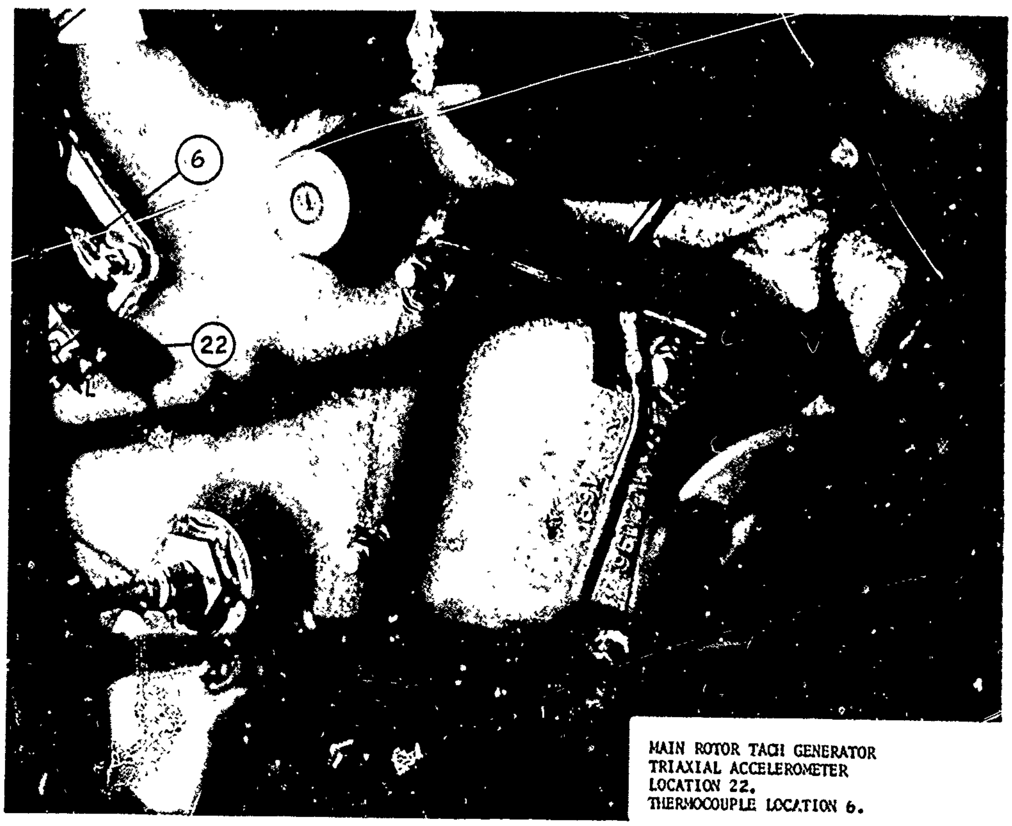


Photo 12.



PILOT STATION
PILOT'S HELMET TRIAXIAL ACCELEROMETER LOCATION 20; PILOT'S BITE BLOCK TRIAXIAL ACCELEROMETER LOCATION 21.

Photo 13



MAIN ROTOR TACH GENERATOR
TRIAXIAL ACCELEROMETER
LOCATION 22.
THERMOCOUPLE LOCATION 6.

Photo 14.

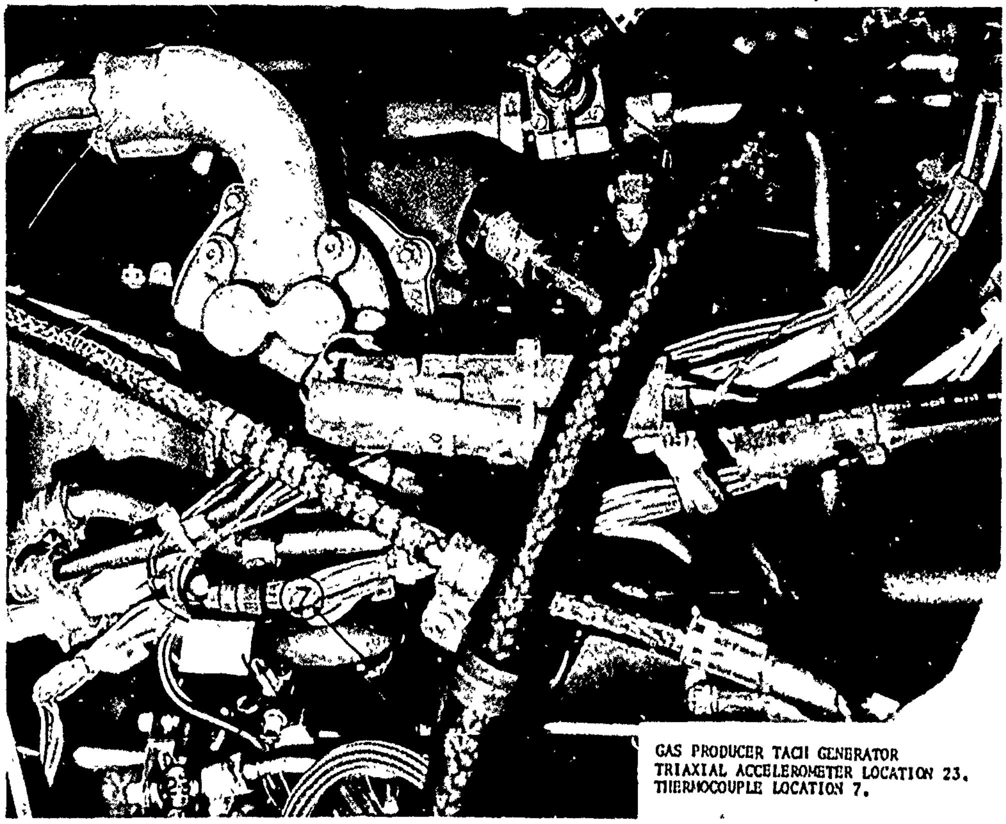


Photo 15.

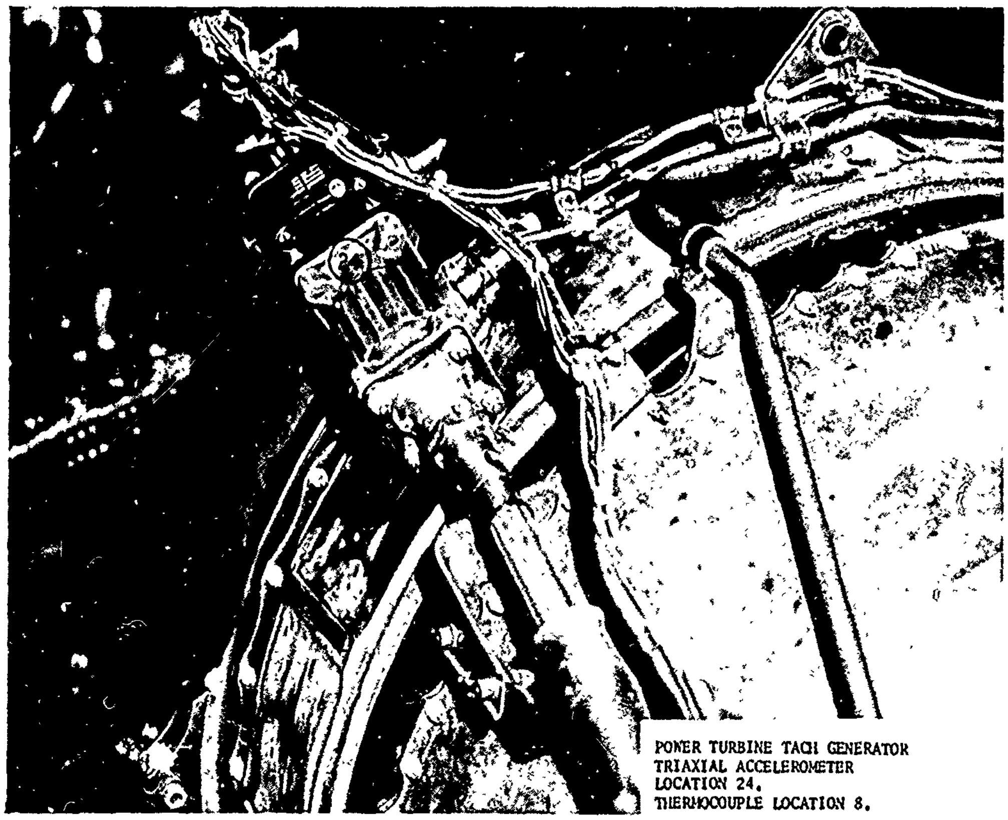


Photo 16.

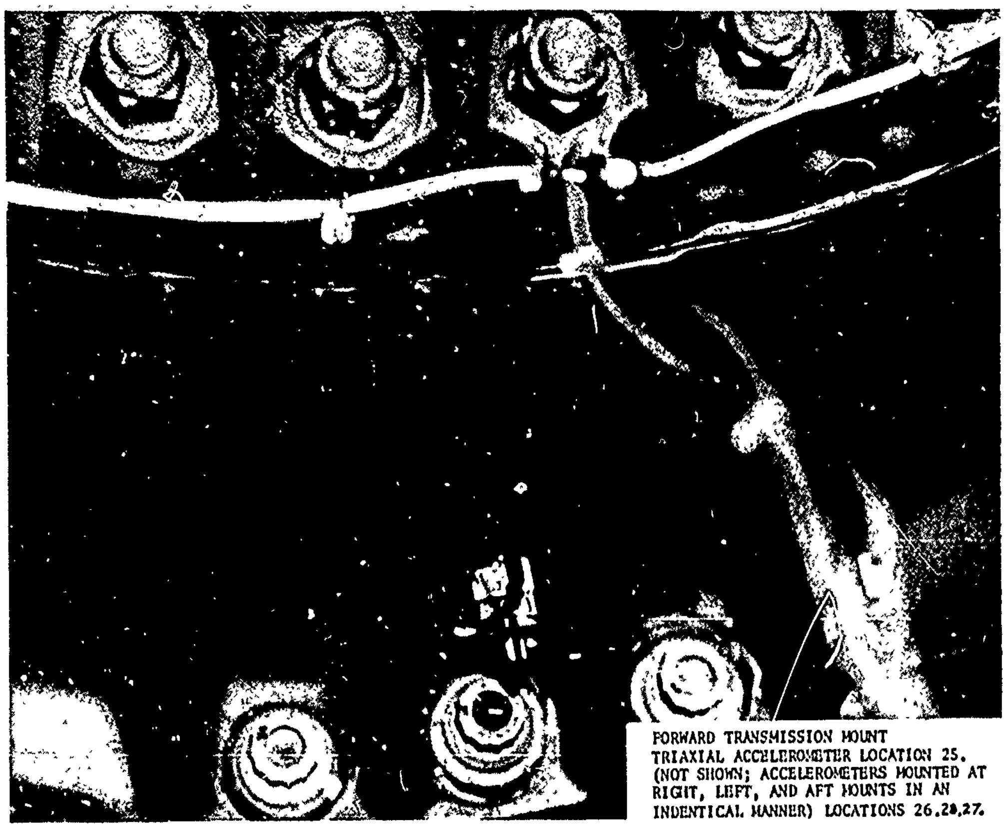


Photo 17.

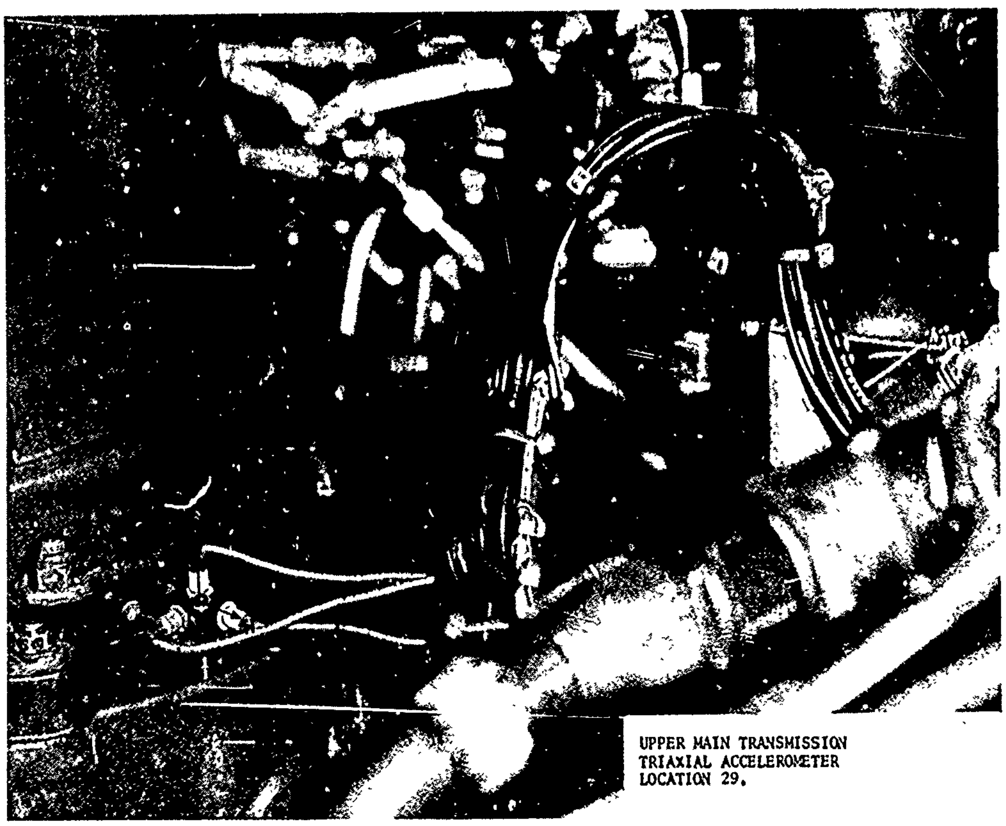
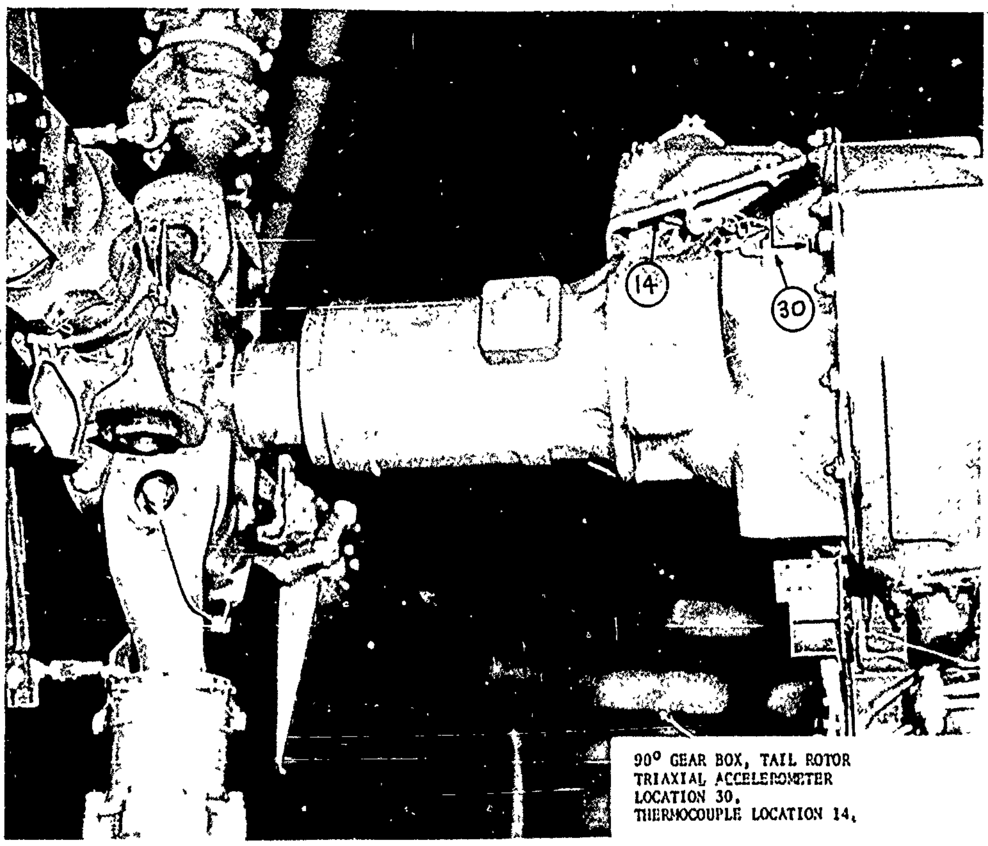
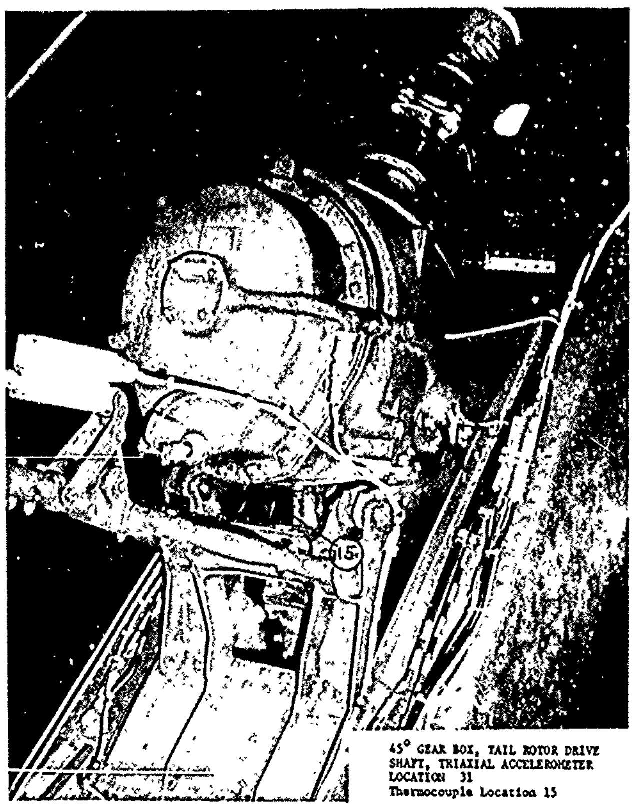


Photo 18.



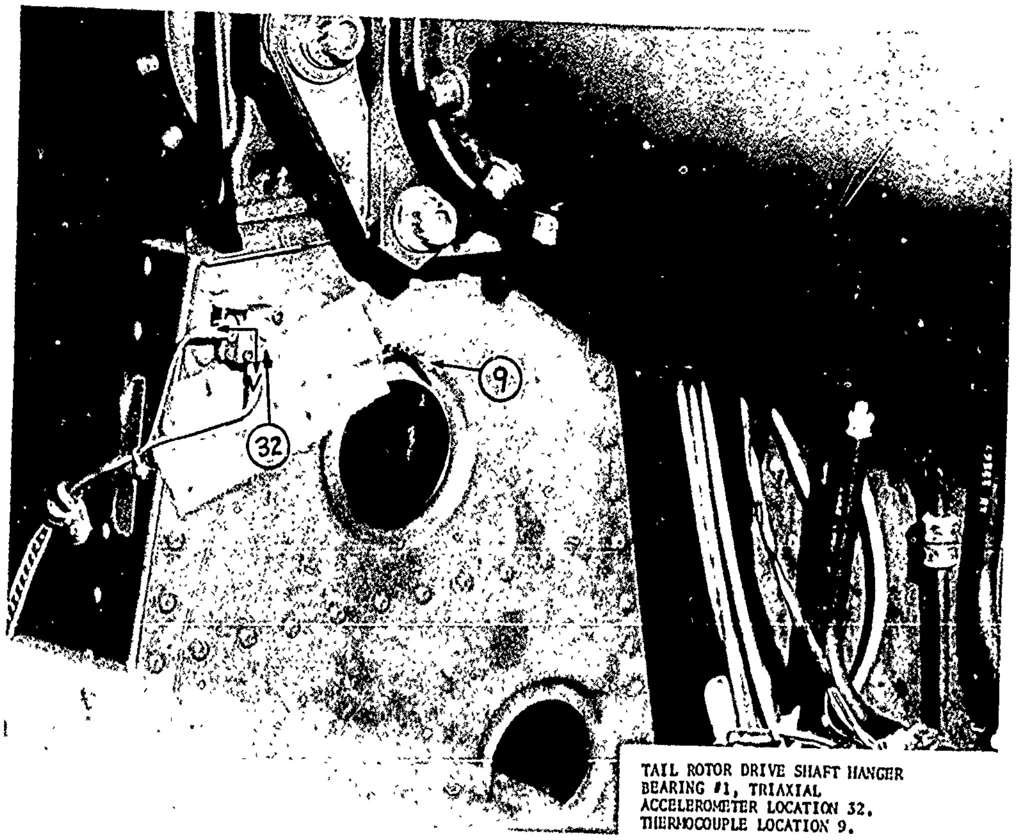
90° GEAR BOX, TAIL ROTOR
TRIAXIAL ACCELEROMETER
LOCATION 30,
THERMOCOUPLE LOCATION 14.

Photo 19.



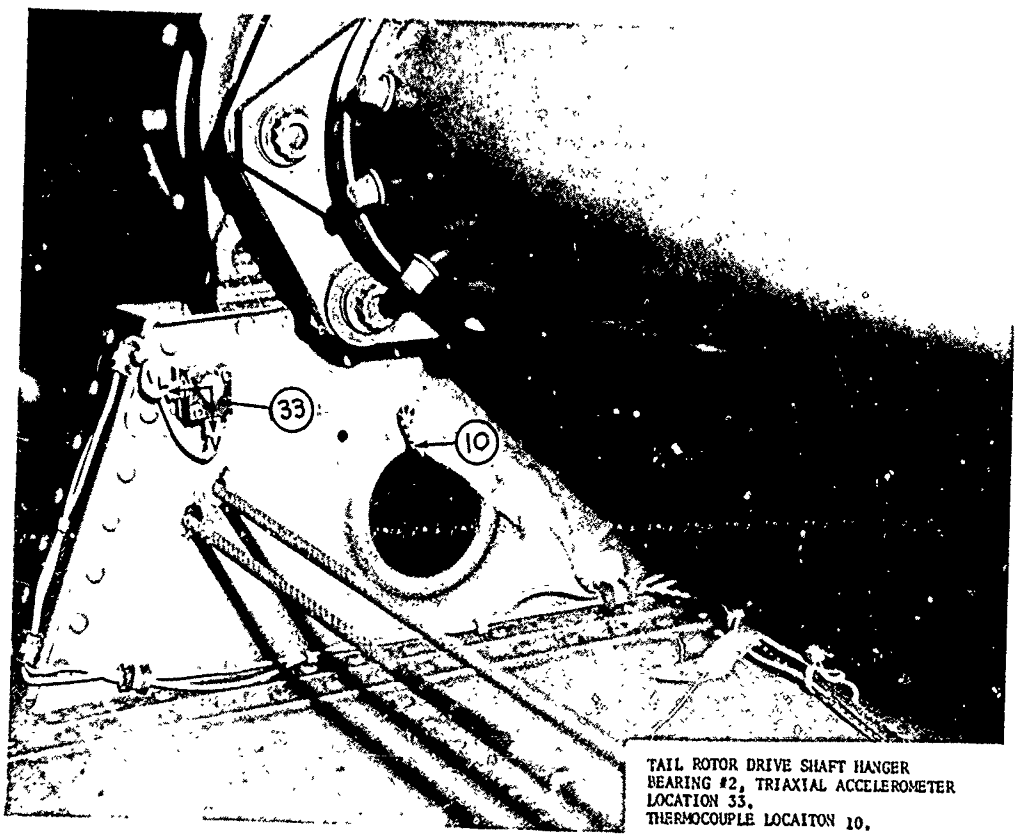
45° GEAR BOX, TAIL ROTOR DRIVE
SHAFT, TRIAXIAL ACCELEROMETER
LOCATION 31
Thermocouple Location 15

Photo 20.



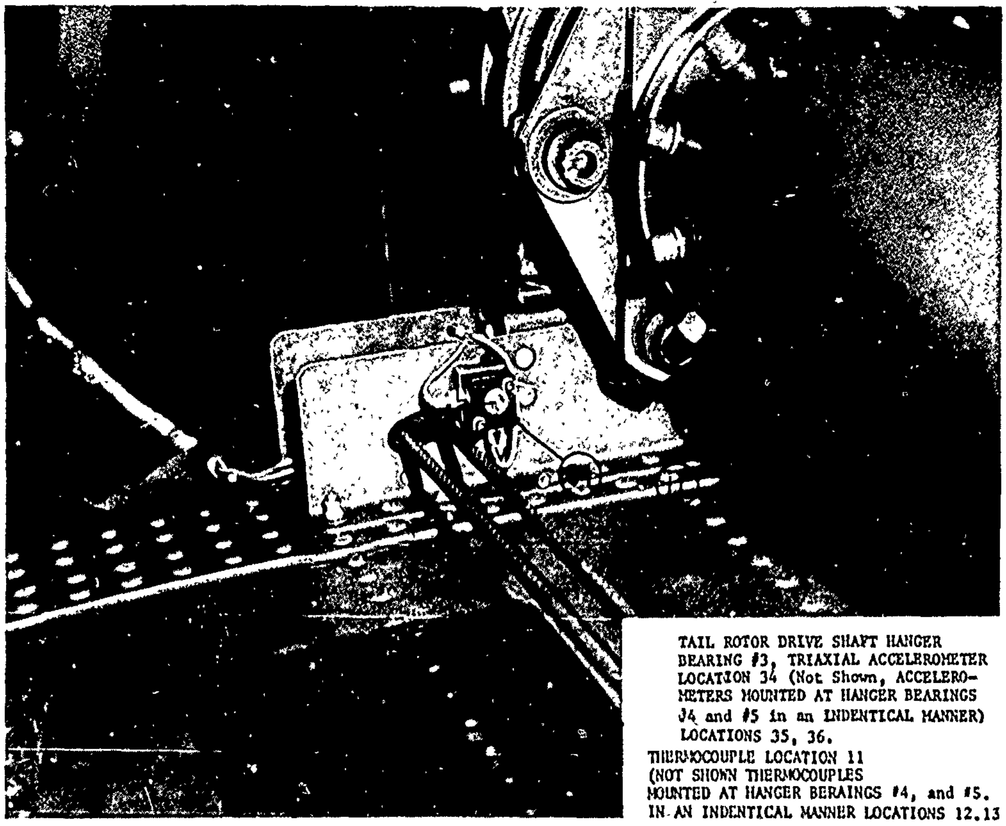
TAIL ROTOR DRIVE SHAFT HANGER BEARING #1, TRIAXIAL ACCELEROMETER LOCATION 32. THERMOCOUPLE LOCATION 9.

Photo 21.



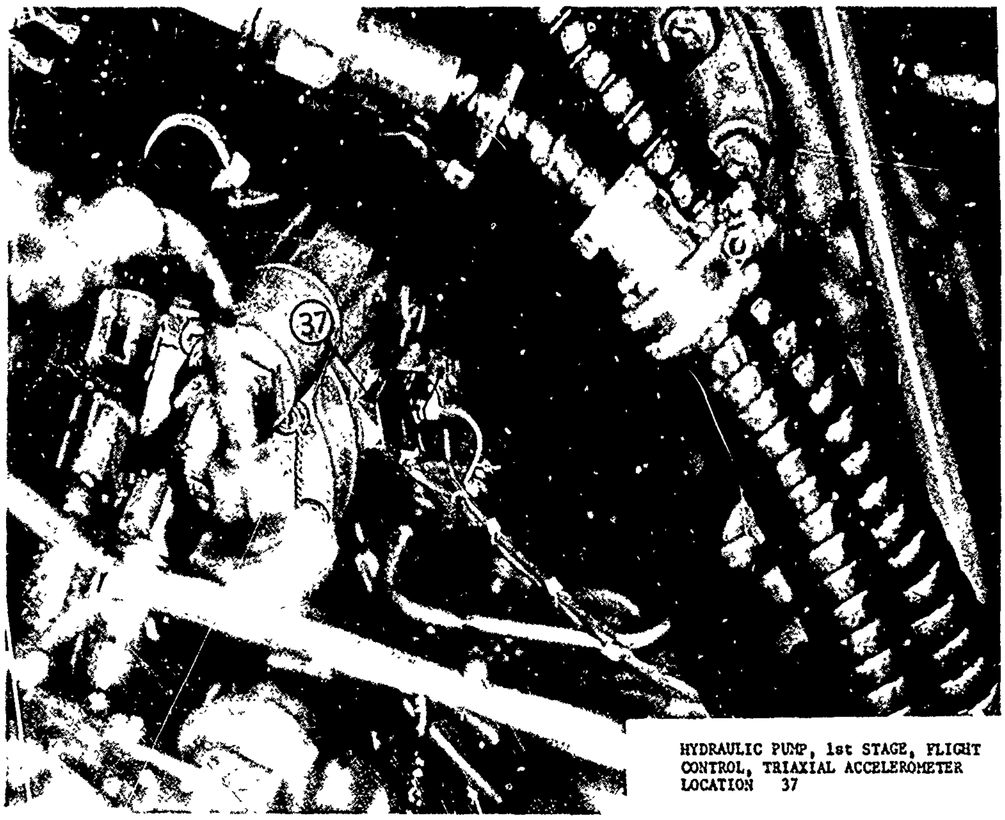
TAIL ROTOR DRIVE SHAFT HANGER BEARING #2, TRIAXIAL ACCELEROMETER LOCATION 33. THERMOCOUPLE LOCAITON 10.

Photo 22.



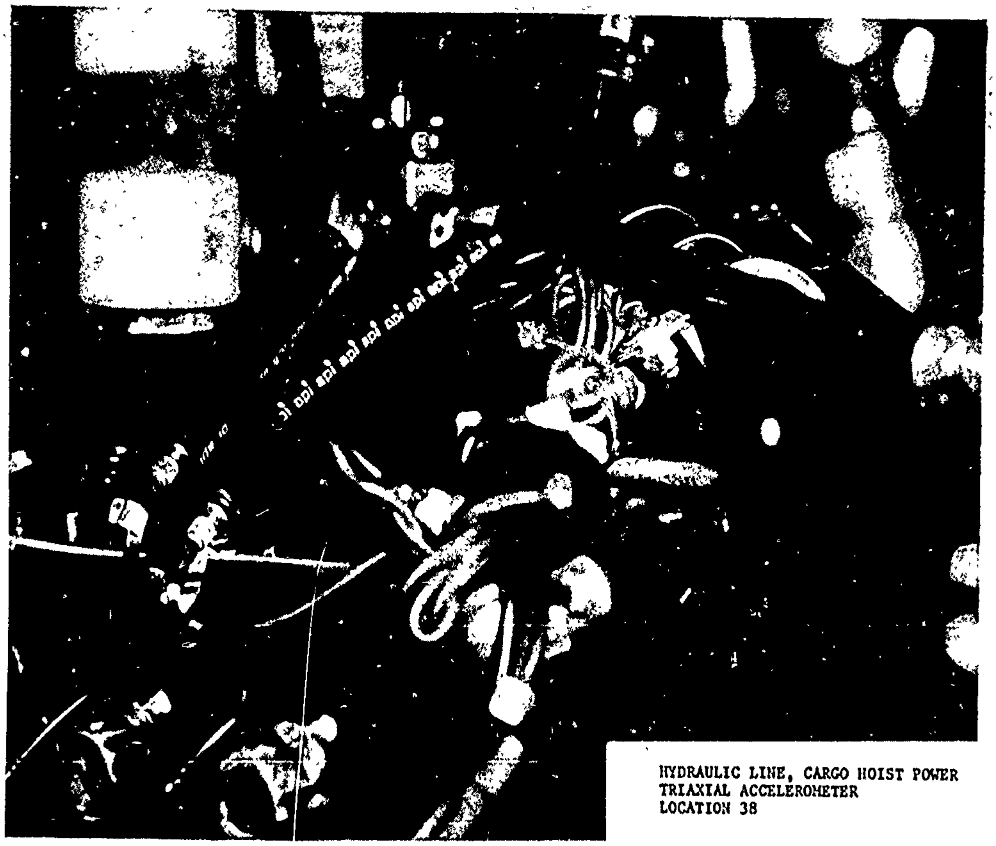
TAIL ROTOR DRIVE SHAFT HANGER BEARING #3, TRIAXIAL ACCELEROMETER LOCATION 34 (Not Shown, ACCELEROMETERS MOUNTED AT HANGER BEARINGS #4 and #5 in an INDENTICAL MANNER) LOCATIONS 35, 36.
THERMOCOUPLE LOCATION 11
(NOT SHOWN THERMOCOUPLES MOUNTED AT HANGER BERAINGS #4, and #5. IN AN INDENTICAL MANNER LOCATIONS 12.13

Photo 23.



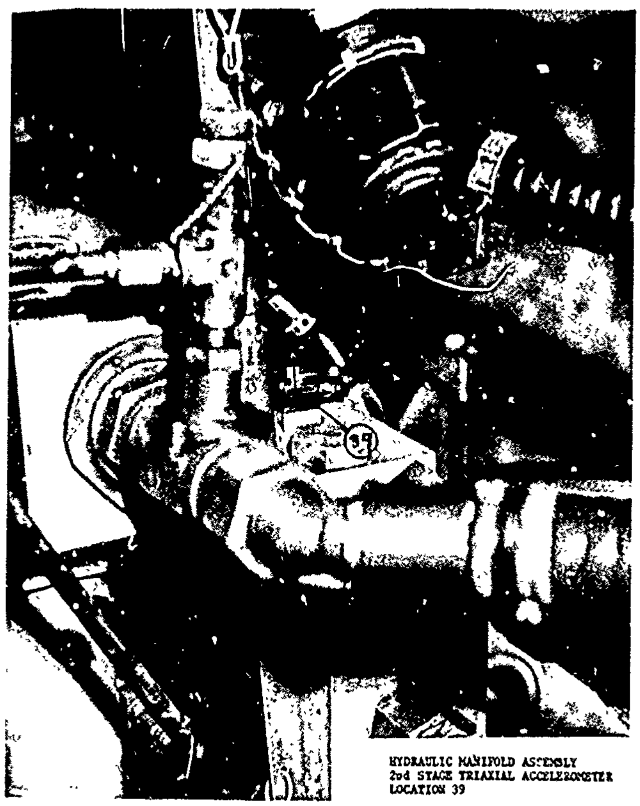
HYDRAULIC PUMP, 1st STAGE, FLIGHT CONTROL, TRIAXIAL ACCELEROMETER LOCATION 37

Photo 24.



HYDRAULIC LINE, CARGO HOIST POWER
TRIAXIAL ACCELEROMETER
LOCATION 38

Photo 25.



HYDRAULIC MANIFOLD ASSEMBLY
2nd STAGE TRIAXIAL ACCELEROMETER
LOCATION 39

Photo 26.

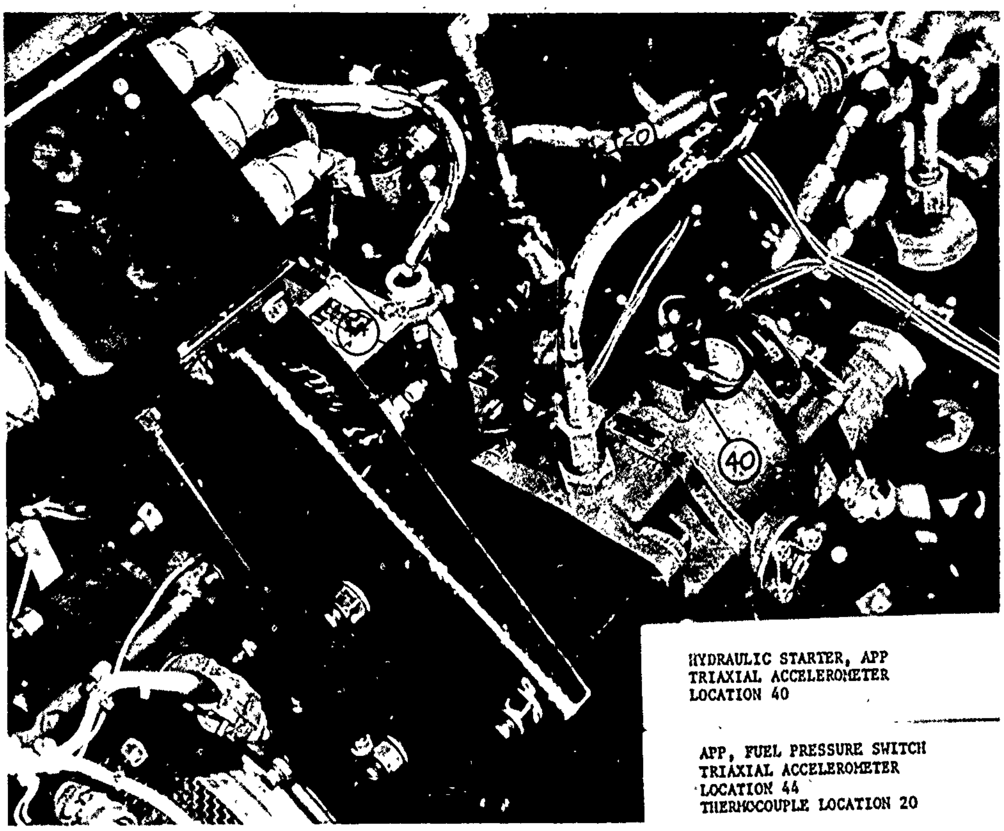


Photo 27.

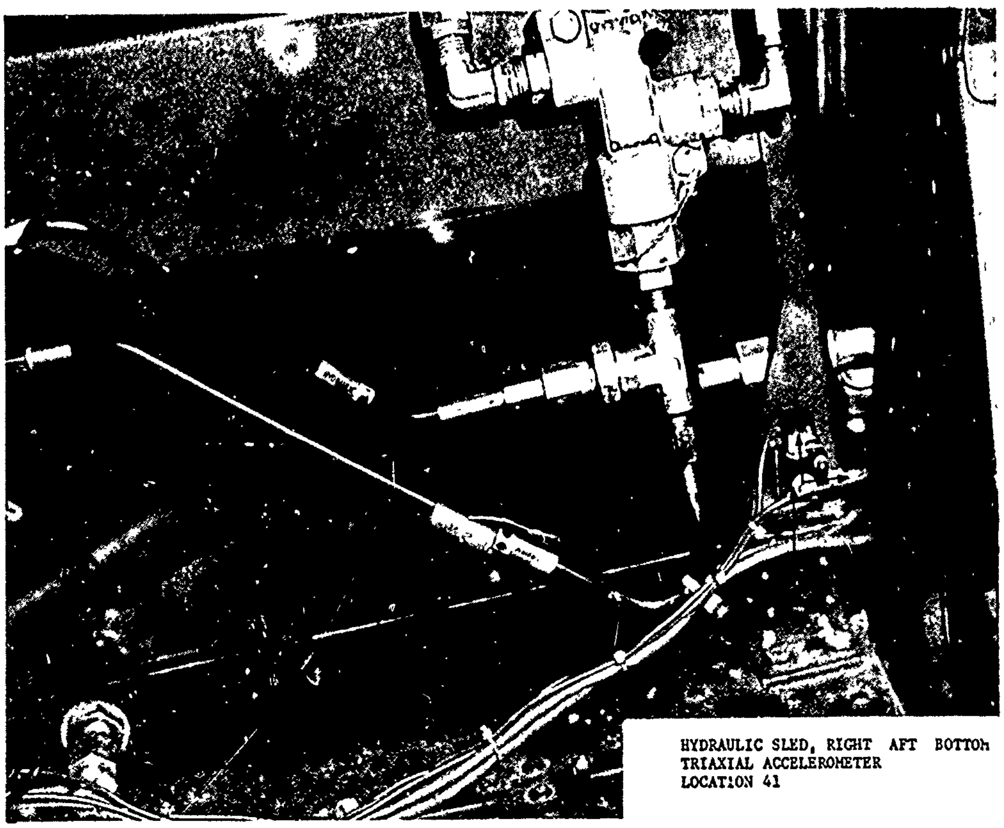


Photo 28.

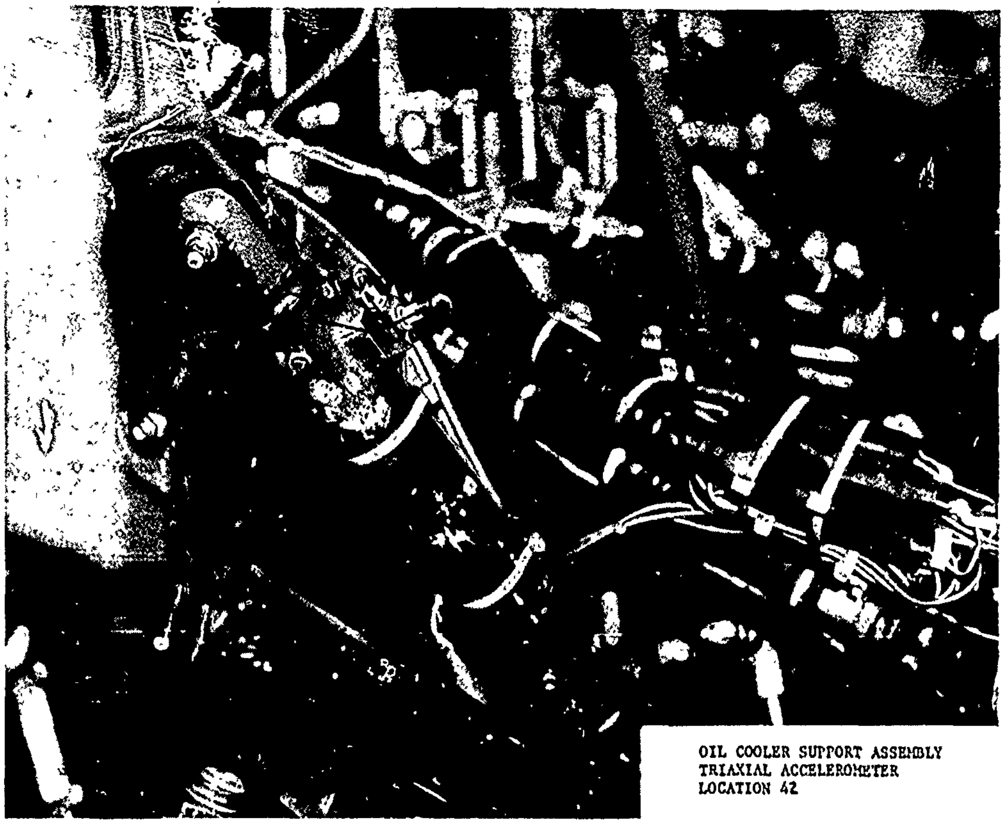


Photo 29.

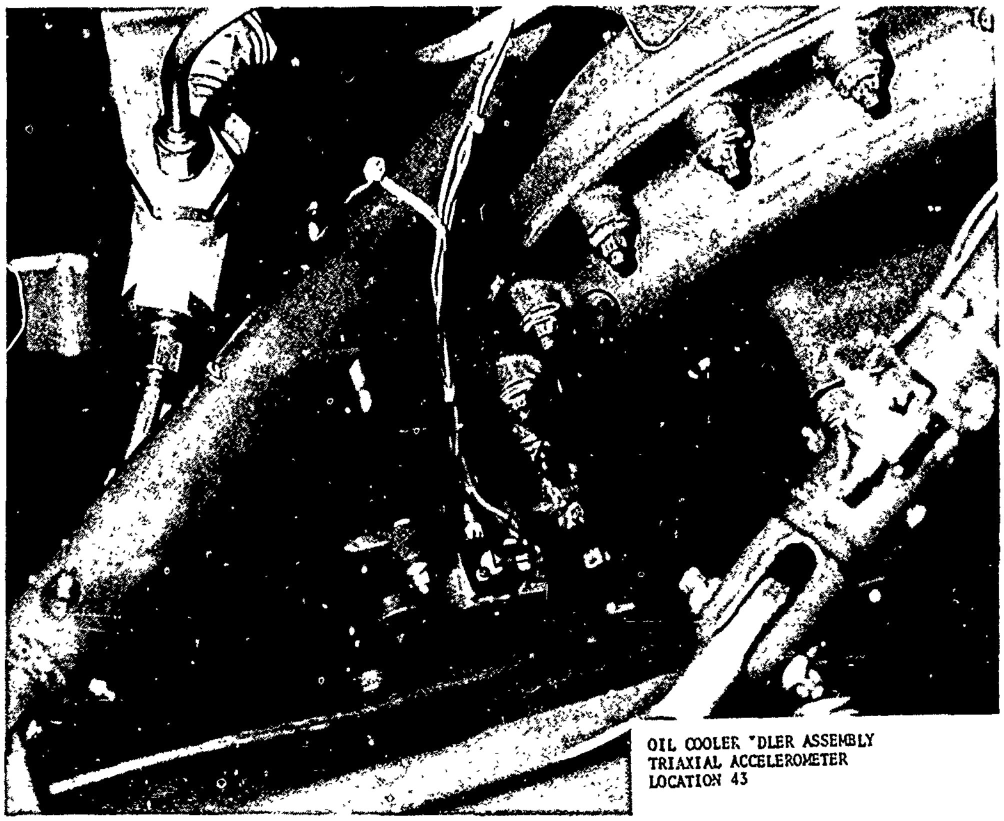
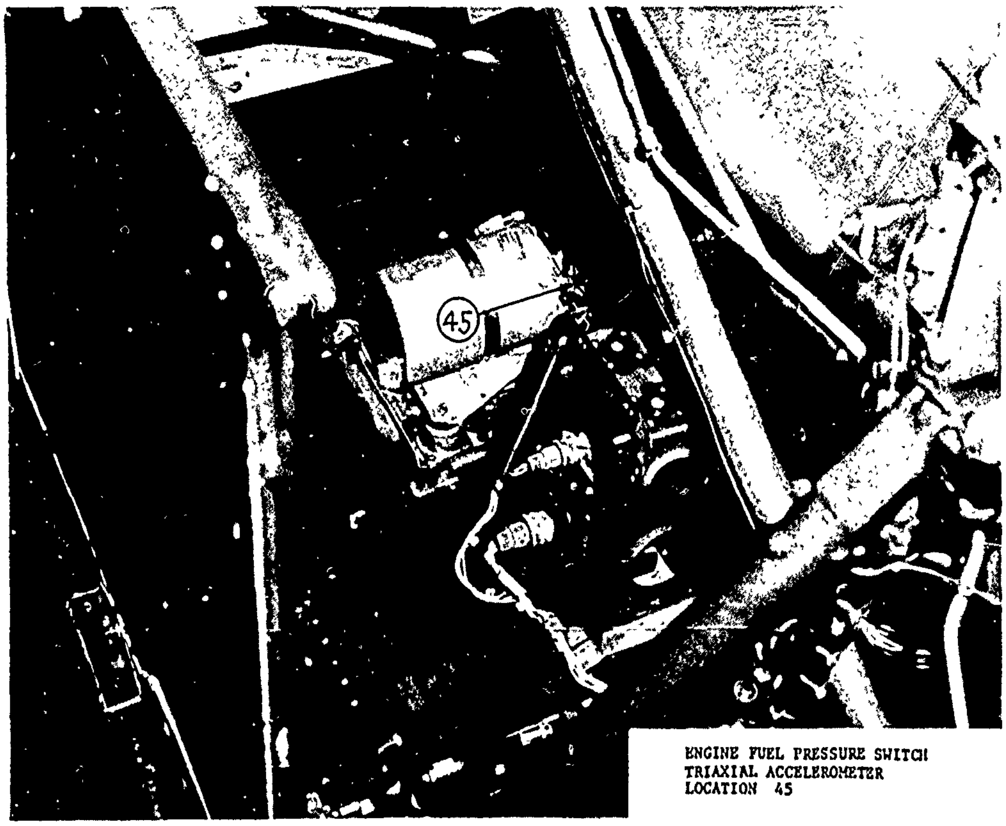
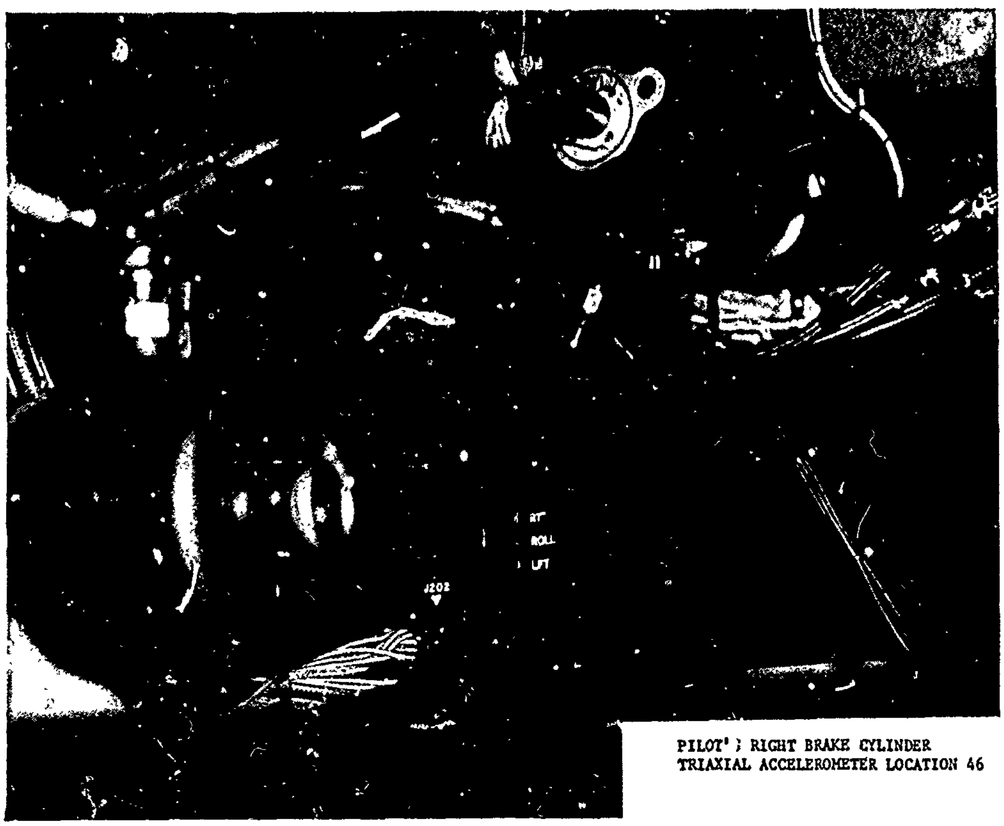


Photo 30.



ENGINE FUEL PRESSURE SWITCH
TRIAXIAL ACCELEROMETER
LOCATION 45

Photo 31.



PILOT'S RIGHT BRAKE CYLINDER
TRIAXIAL ACCELEROMETER LOCATION 46

Photo 32.

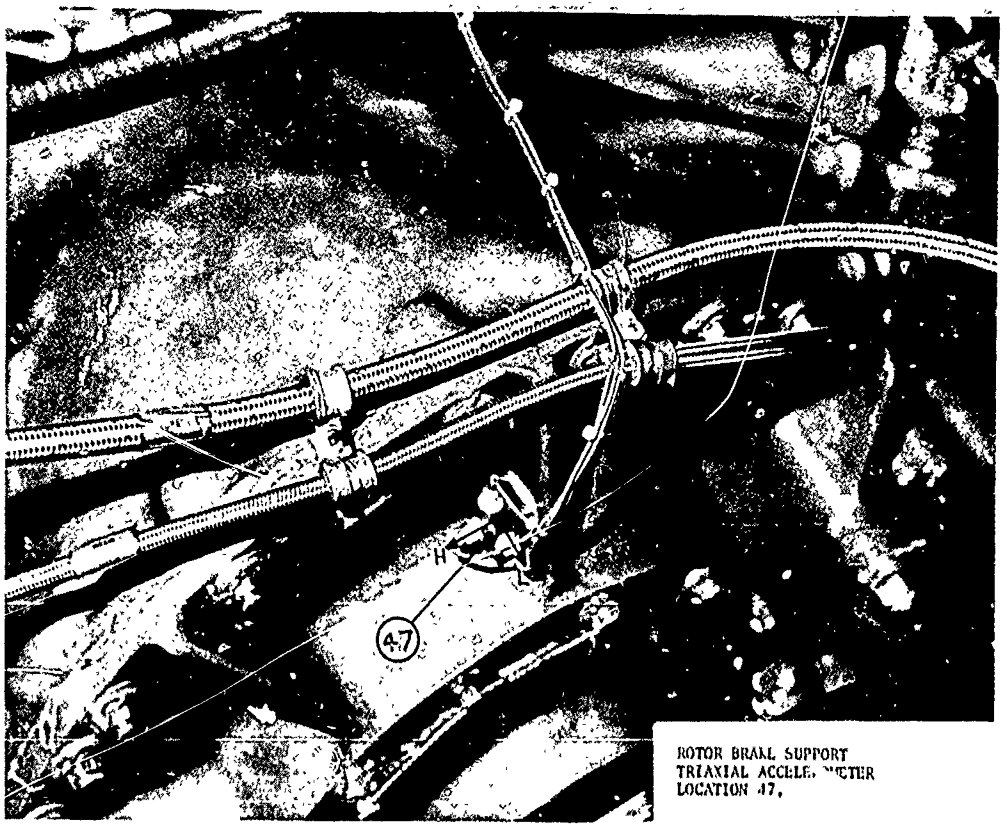


Photo 33.

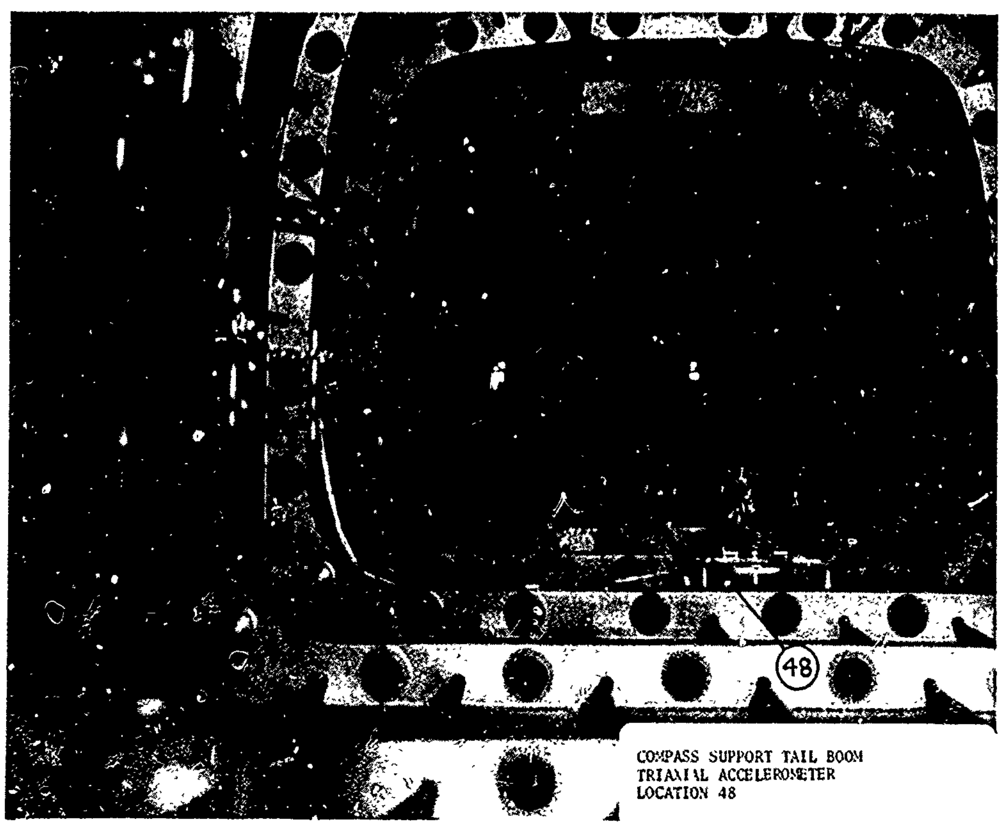
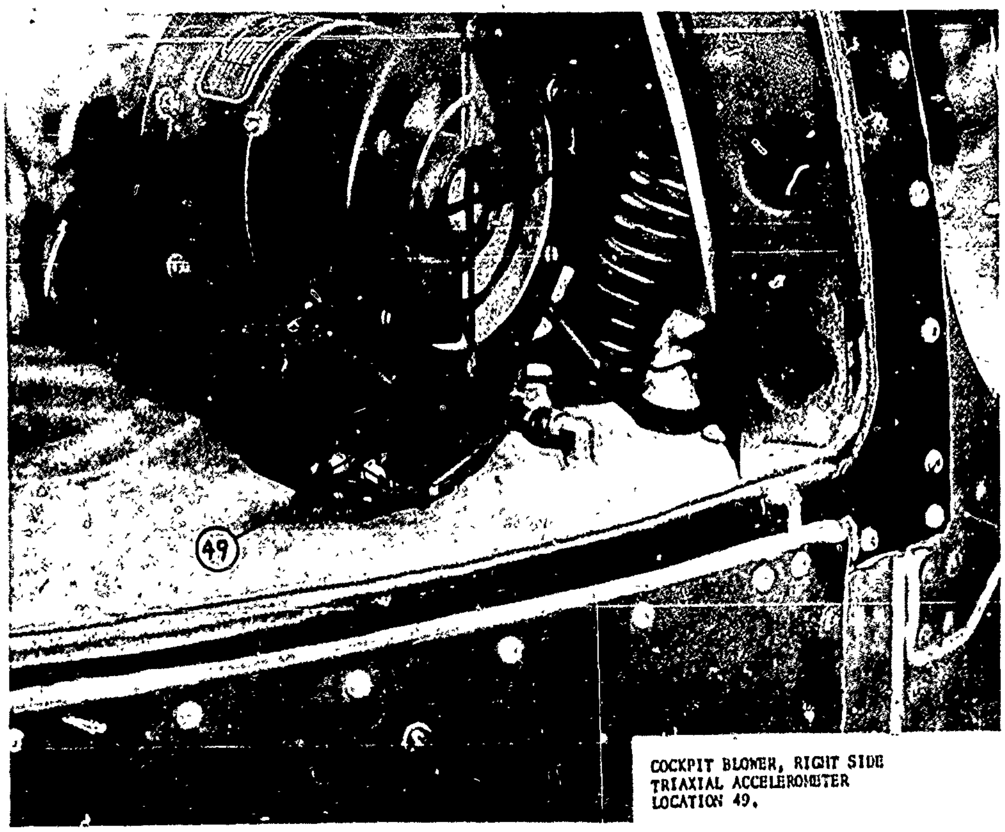
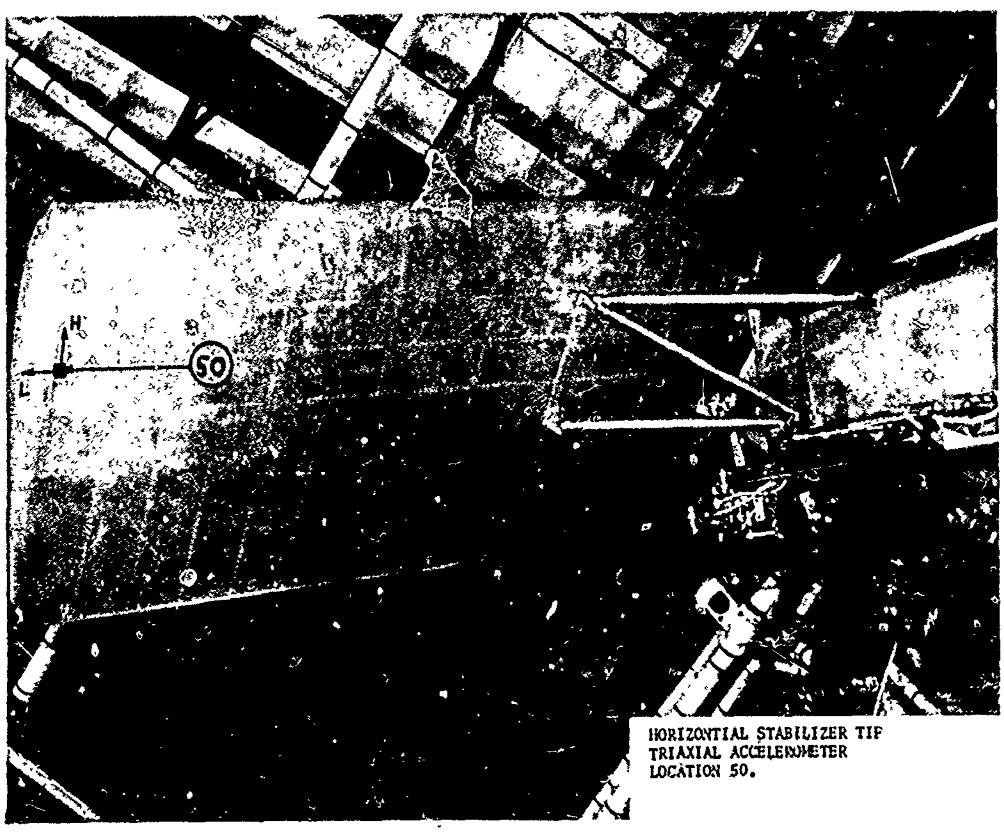


Photo 34.



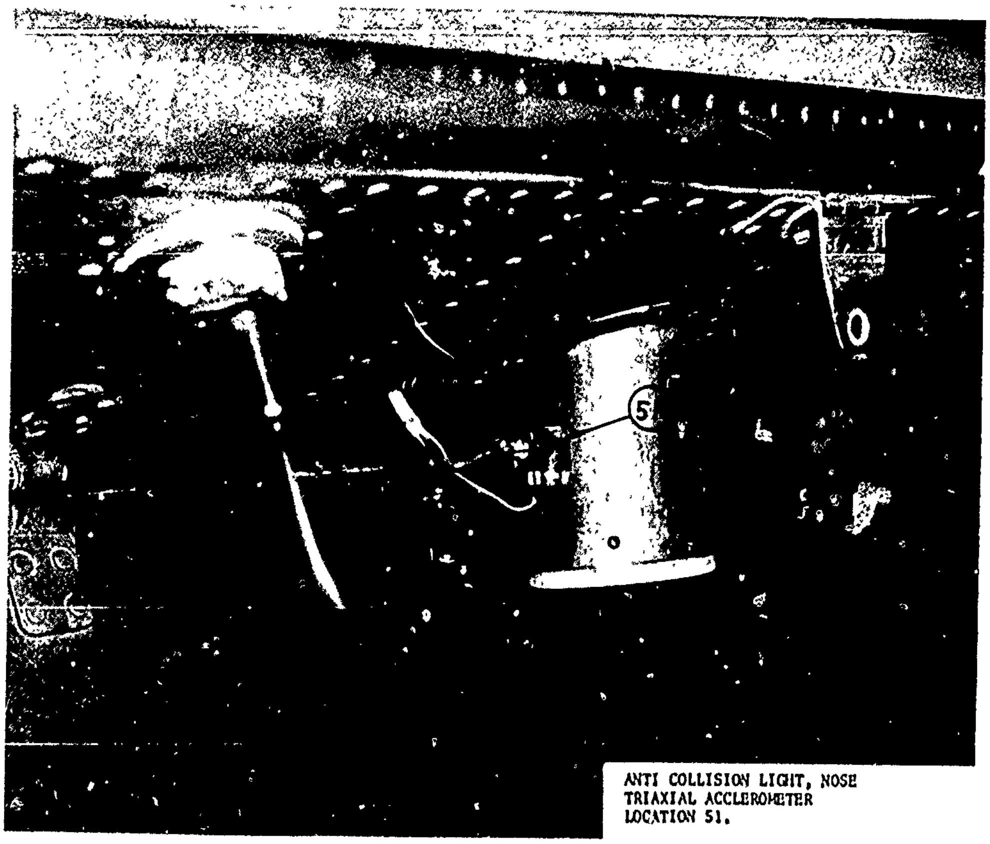
COCKPIT BLOWER, RIGHT SIDE
TRIAXIAL ACCELEROMETER
LOCATION 49.

Photo 35.



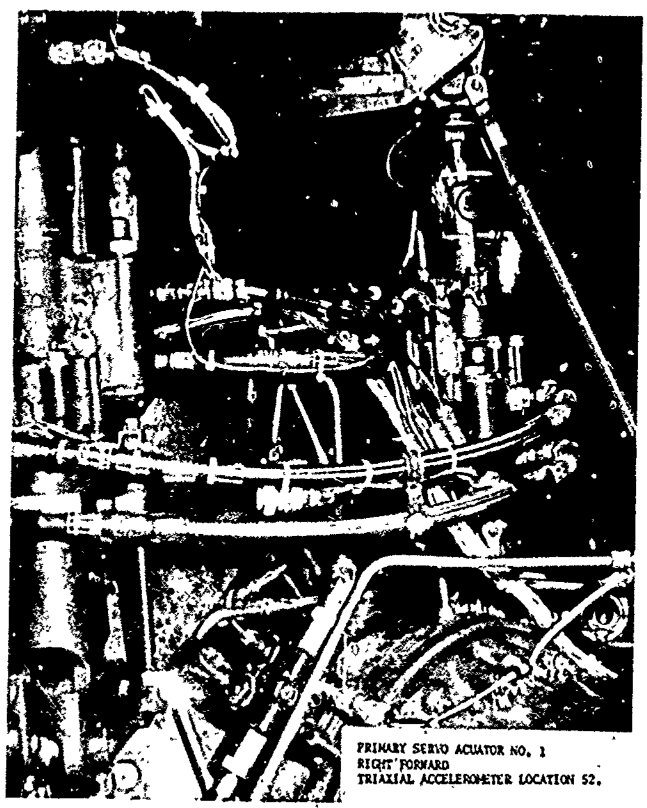
HORIZONTIAL STABILIZER TIP
TRIAXIAL ACCELEROMETER
LOCATION 50.

Photo 36.



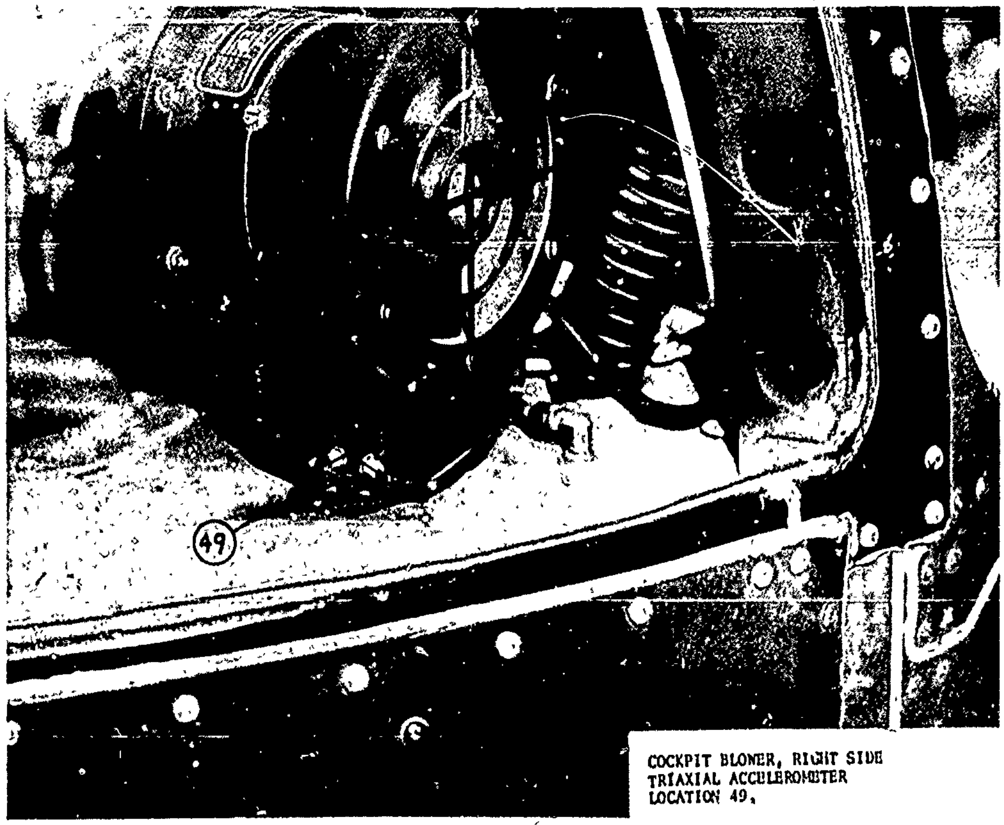
ANTI COLLISION LIGHT, NOSE
TRIAXIAL ACCLEROMETER
LOCATION 51.

Photo 37.



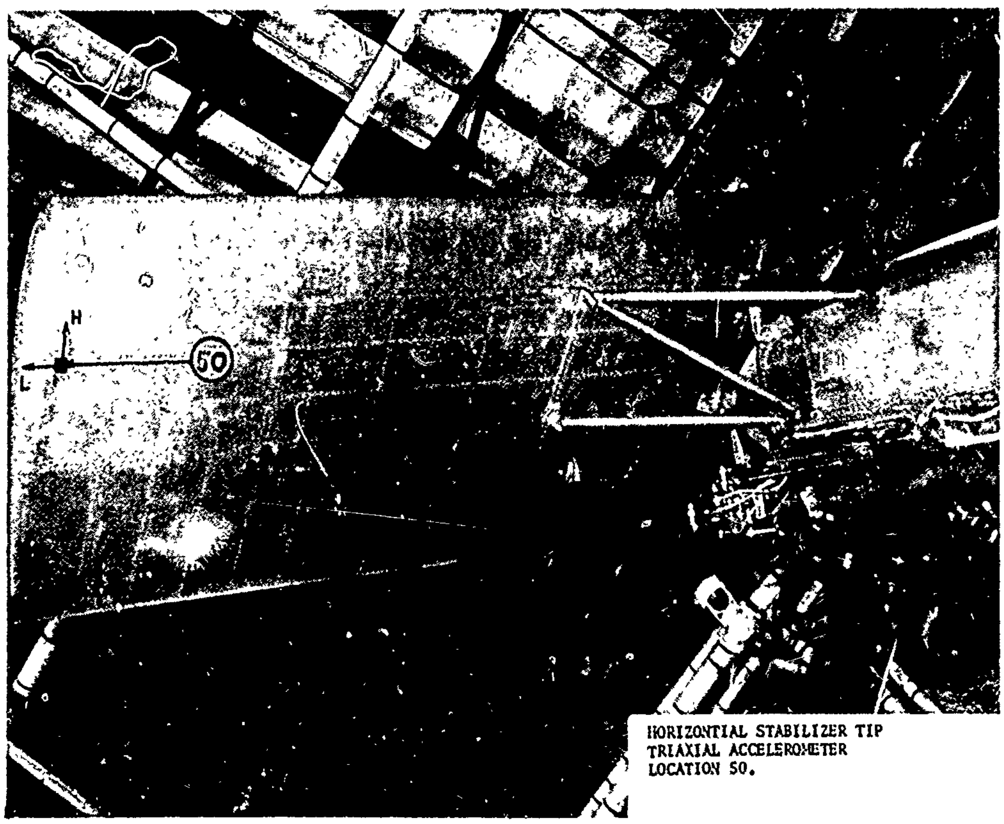
PRIMARY SERVO ACUATOR NO. 1
RIGHT FORWARD
TRIAXIAL ACCELEROMETER LOCATION 52.

Photo 38.



COCKPIT BLOWER, RIGHT SIDE
TRIAXIAL ACCELEROMETER
LOCATION 49.

Photo 35.



HORIZONTIAL STABILIZER TIP
TRIAXIAL ACCELEROMETER
LOCATION 50.

Photo 36.

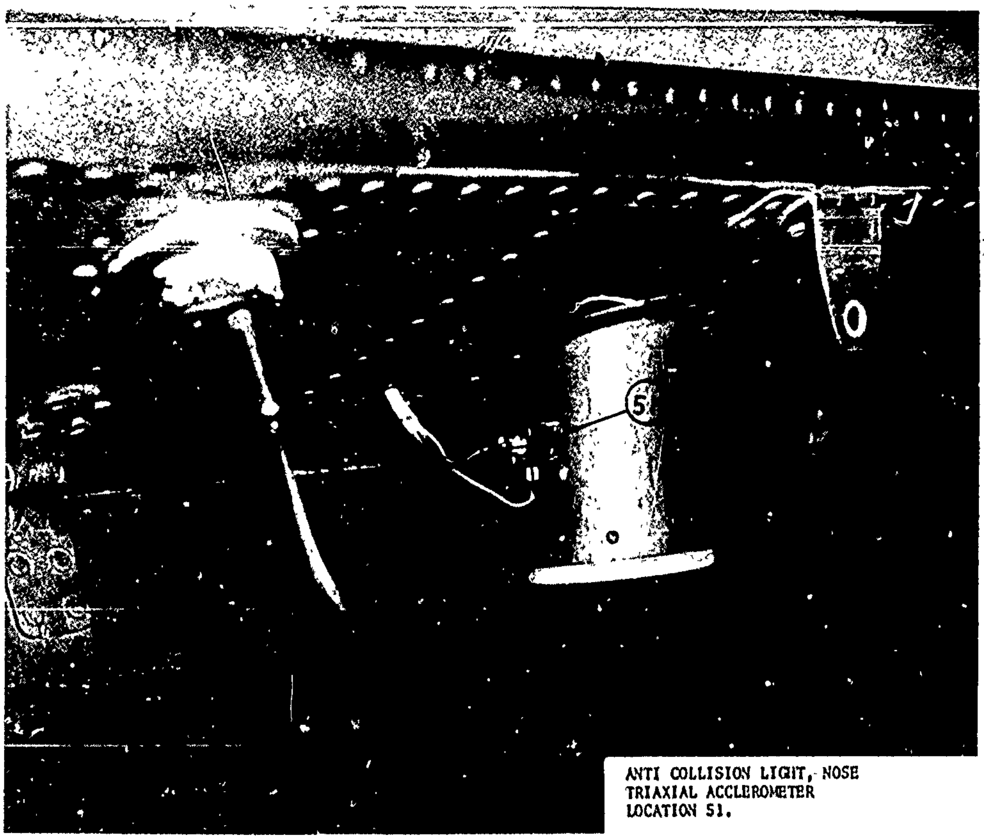


Photo 37.

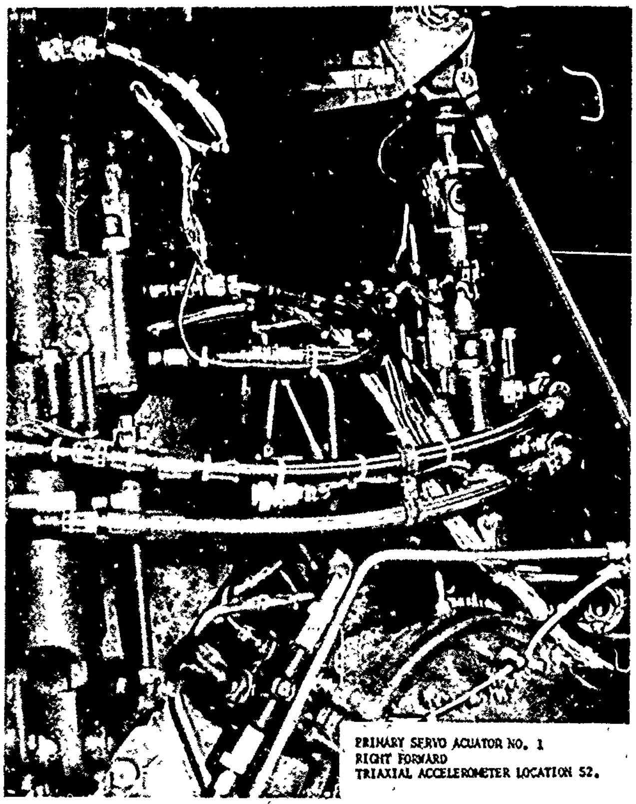


Photo 38.

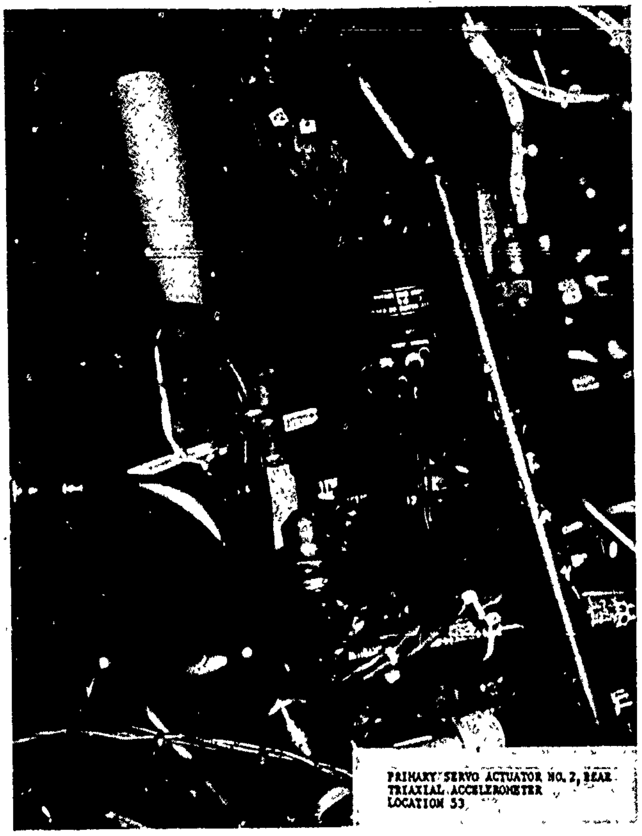


Photo 39.

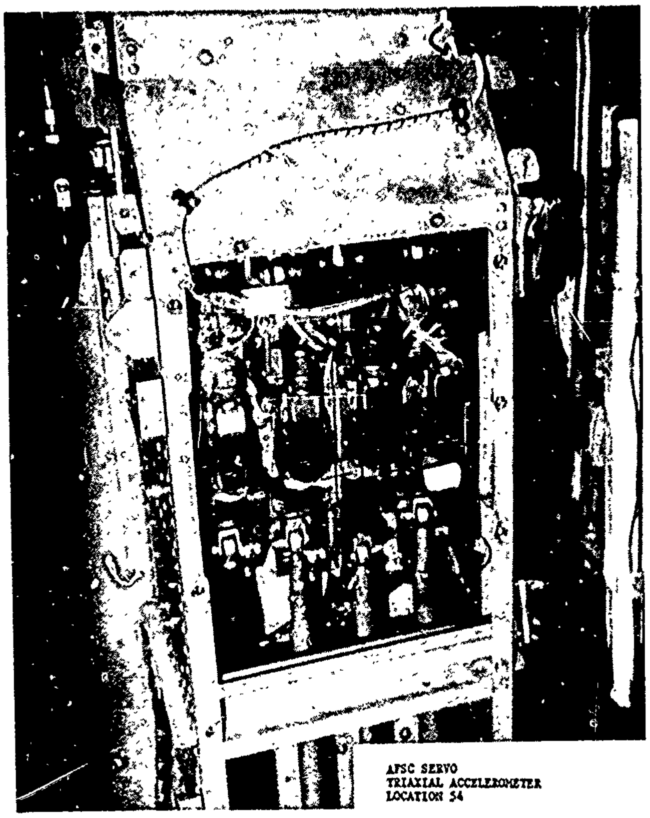


Photo 40.

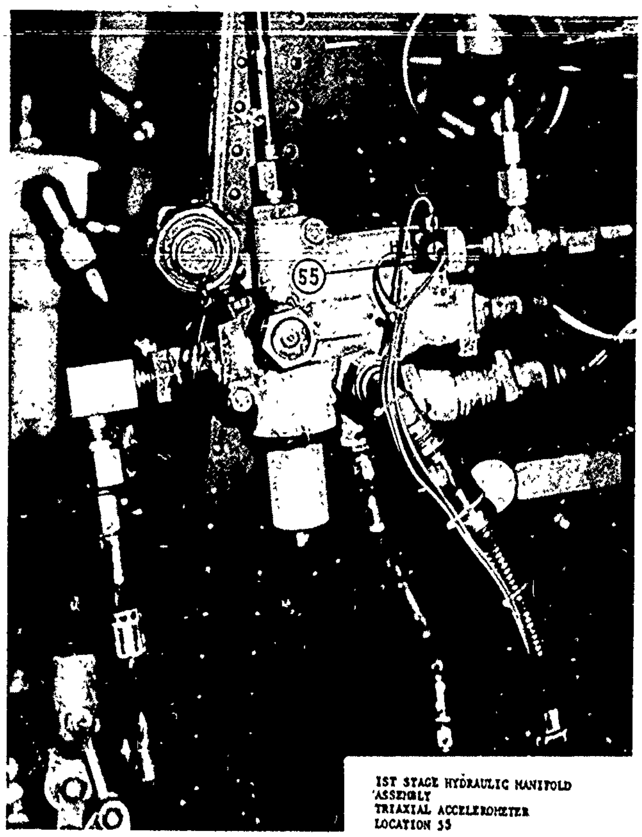


Photo 41.

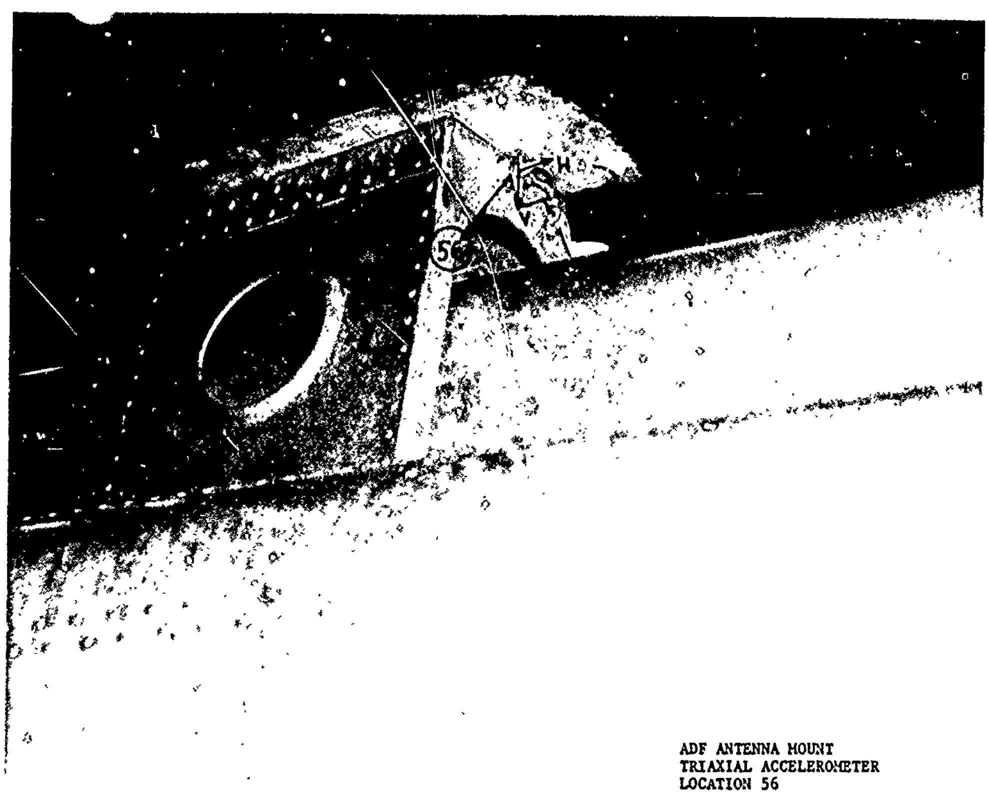
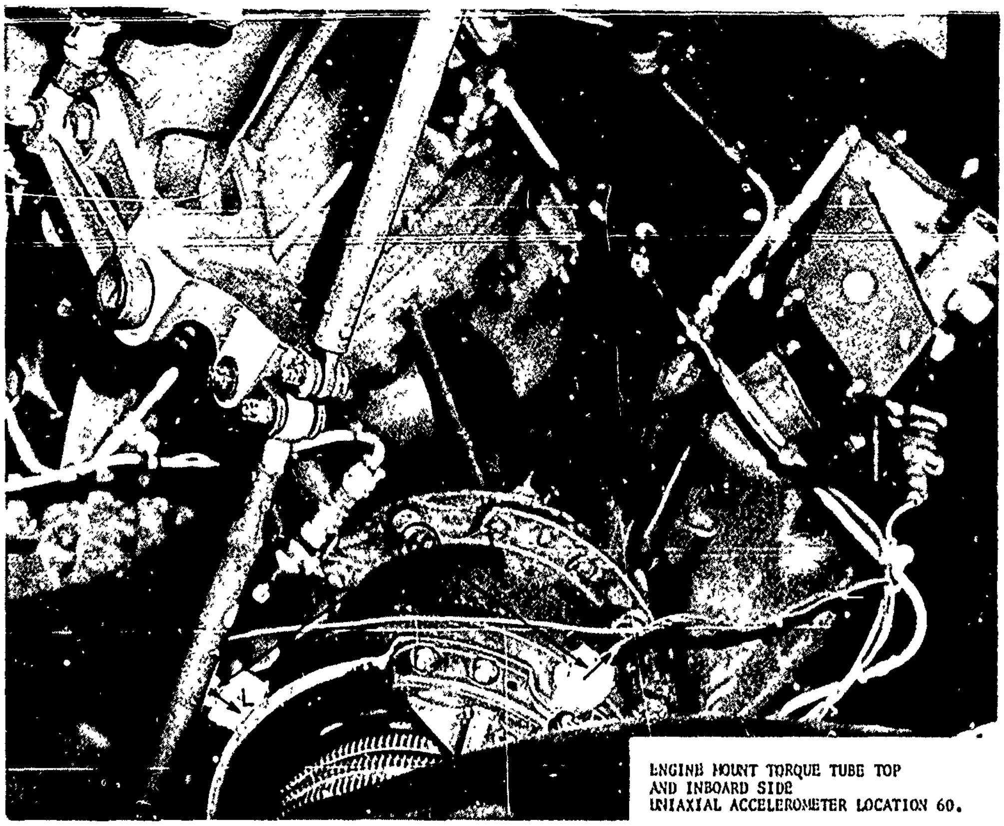


Photo 42.

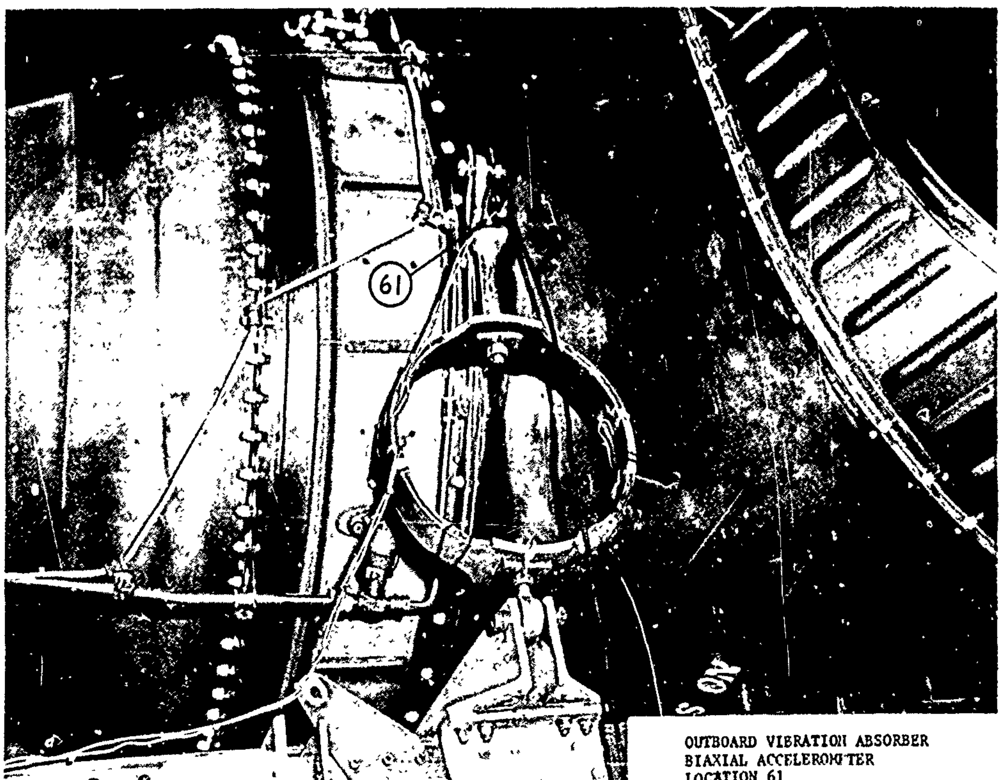
Photo 43.

Photo 44.



ENGINE MOUNT TORQUE TUBE TOP
AND INBOARD SIDE
UNIAXIAL ACCELEROMETER LOCATION 60.

Photo 45.



OUTBOARD VIBRATION ABSORBER
BIAXIAL ACCELEROMETER
LOCATION 61

Photo 46.

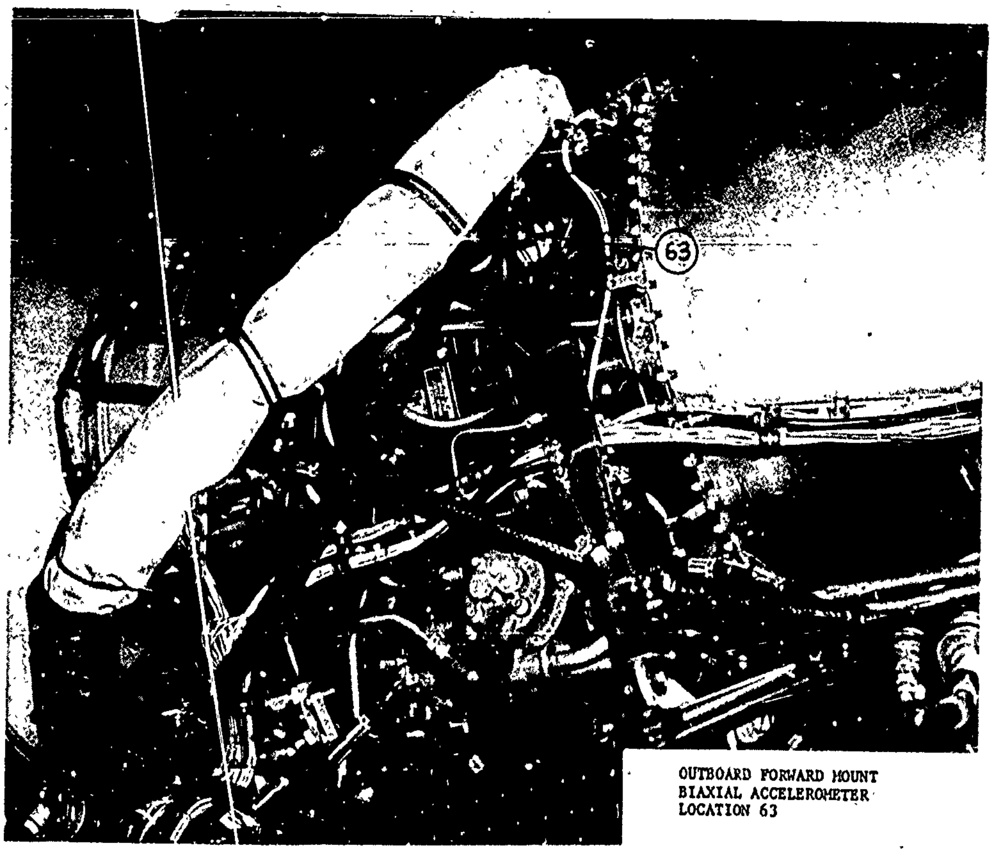


Photo 47.

Photo 48.

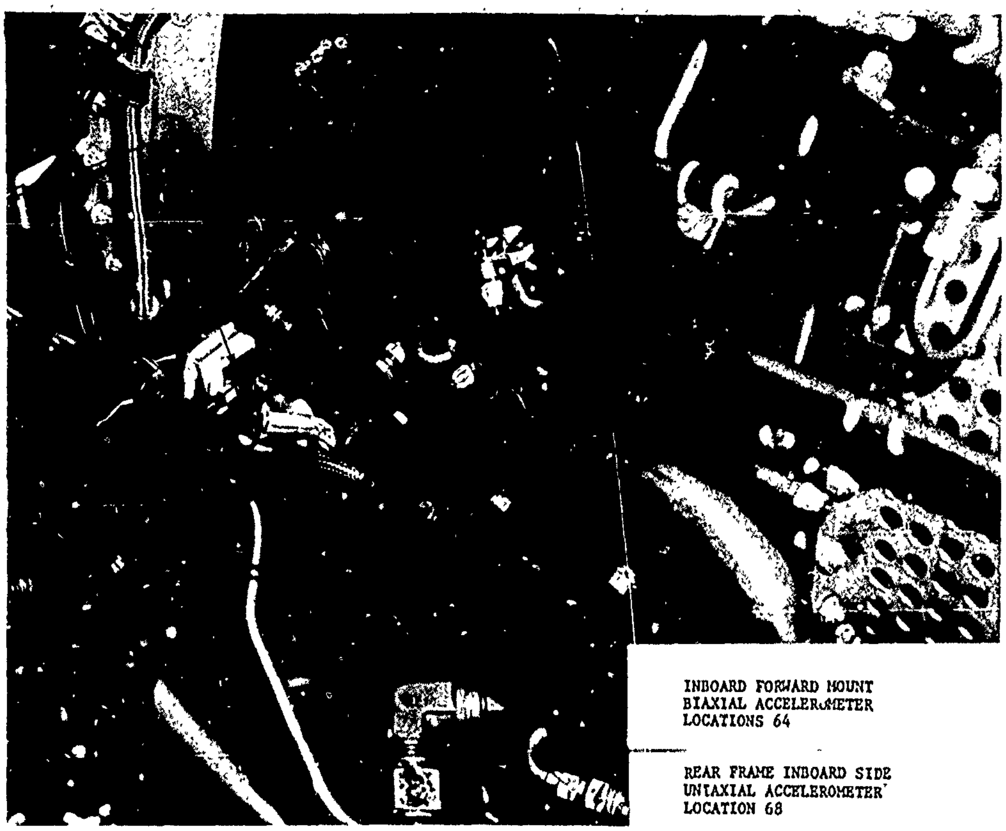


Photo 49.

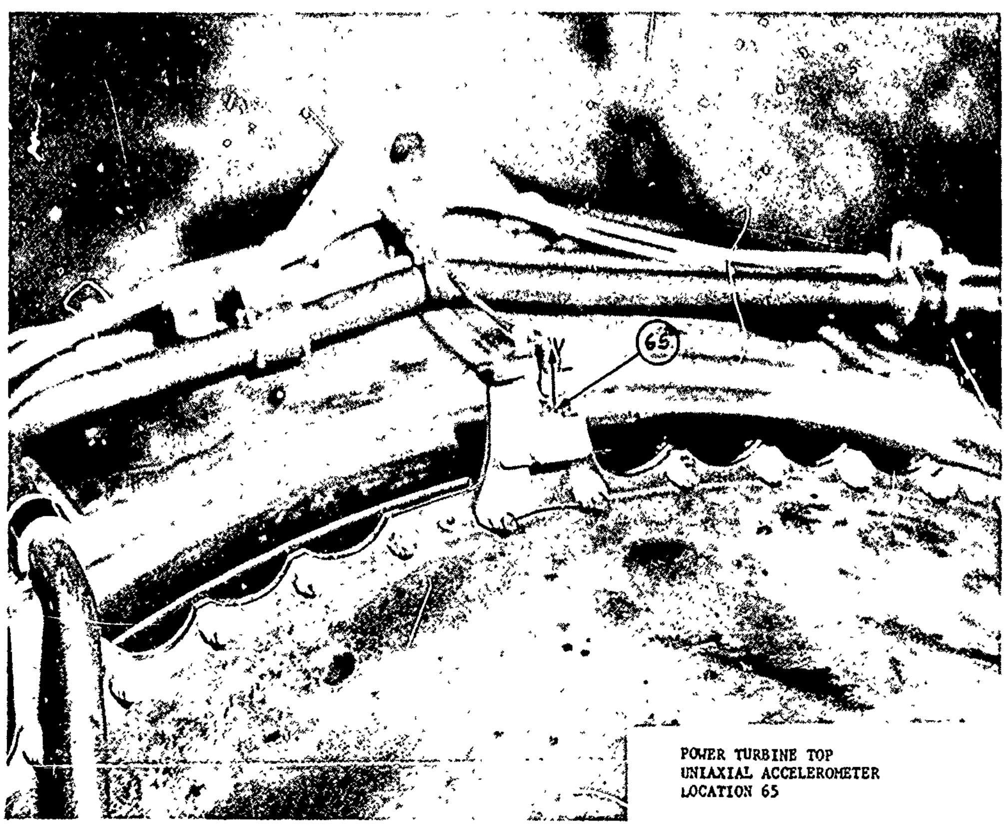


Photo 50.

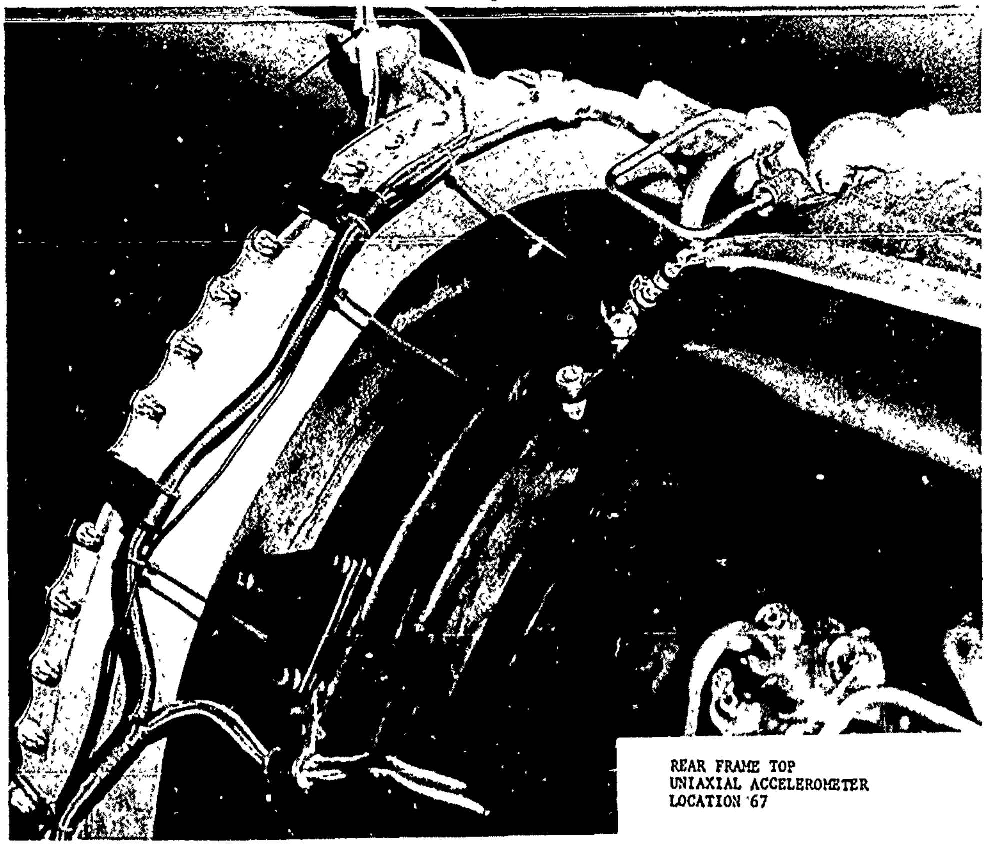


Photo 51.

Photo 52.

Photo 53.

Photo 54.

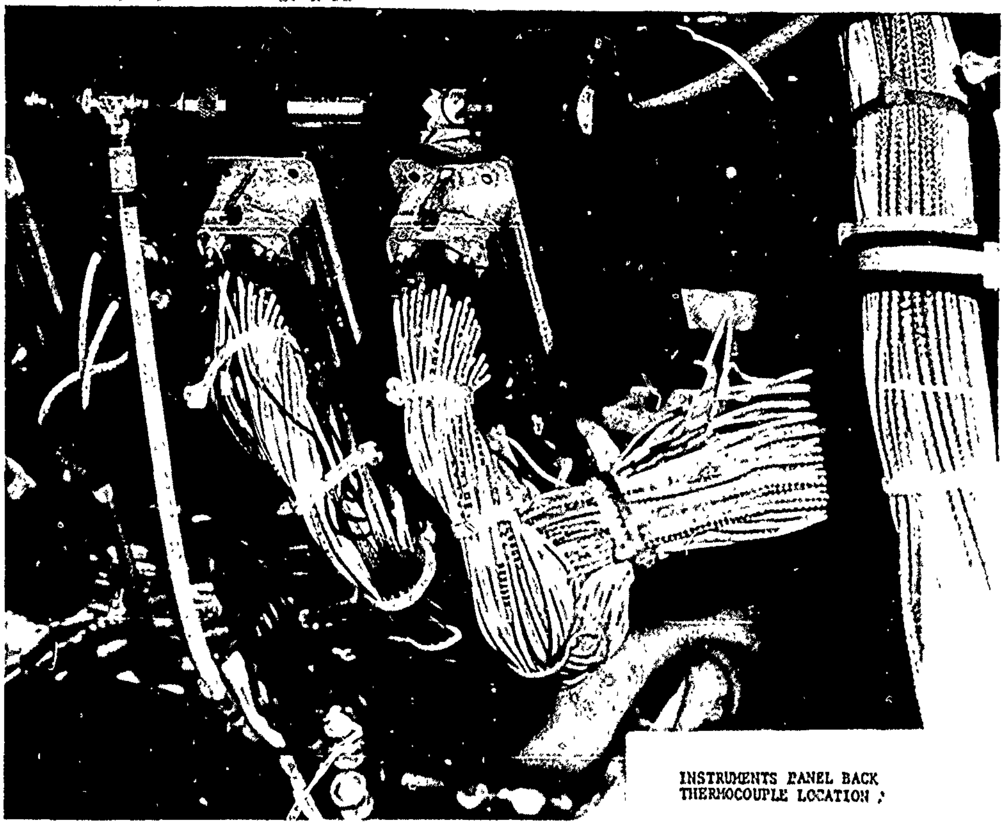


Photo 55.

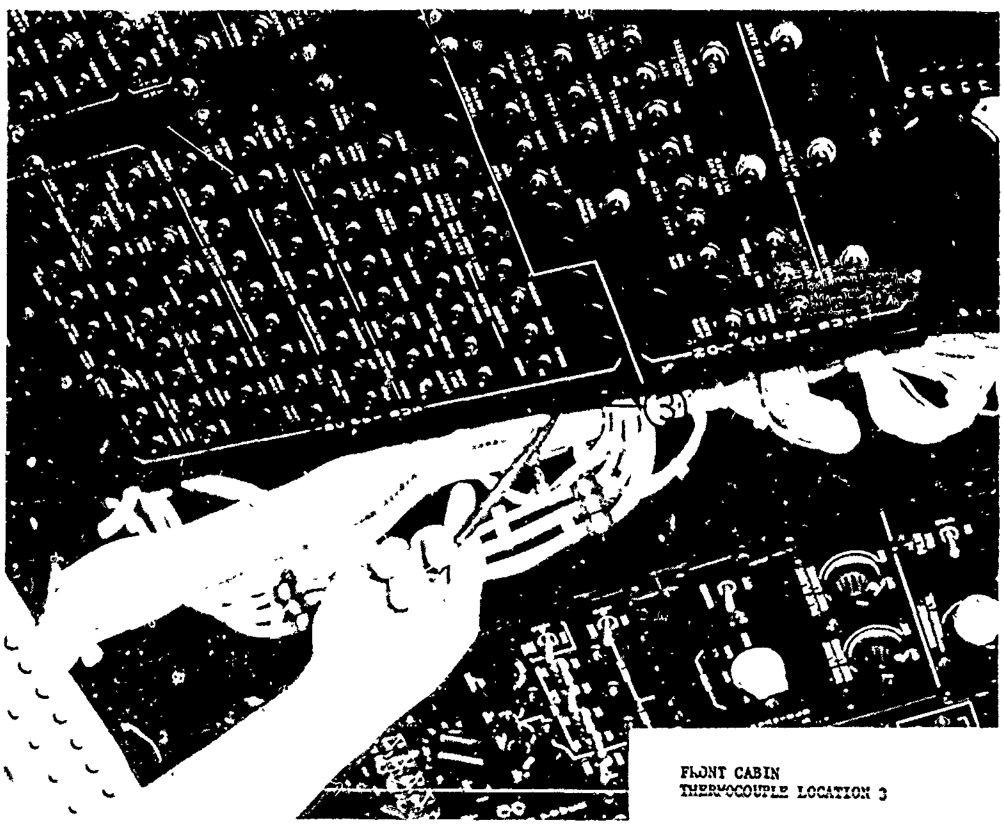


Photo 56.

Photo 57.

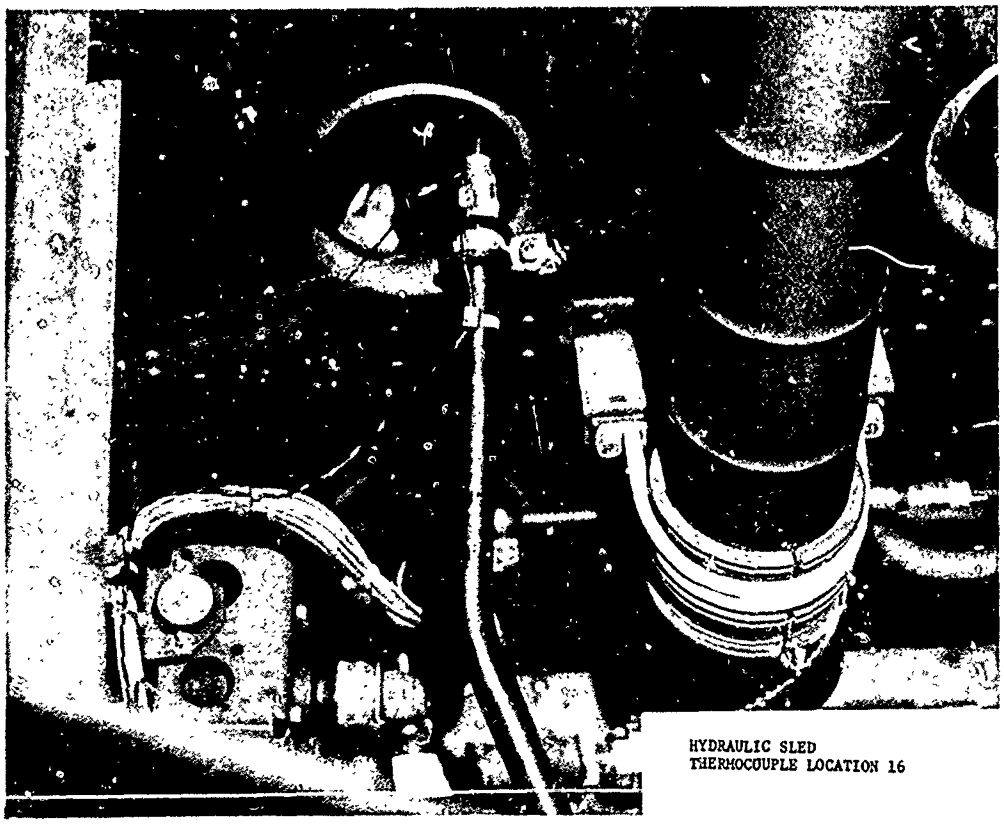


Photo 58.

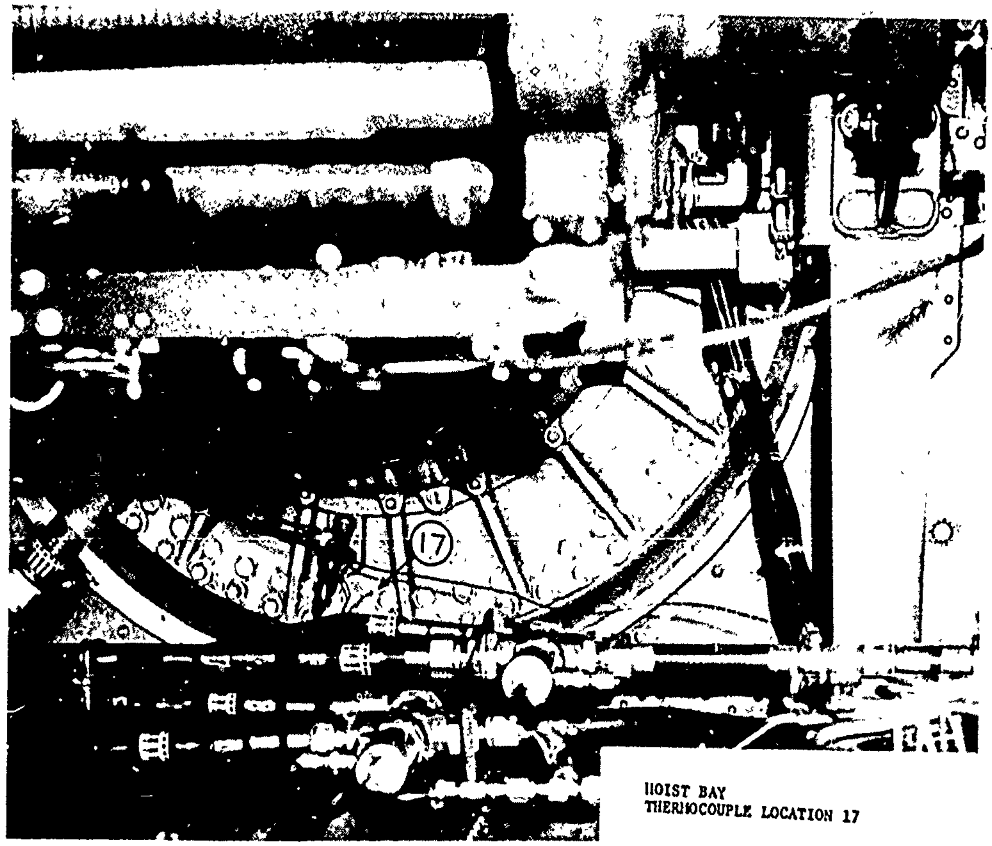


Photo 59.

Photo 60.

WET BULB GLOBE TEMPERATURE
SENSOR

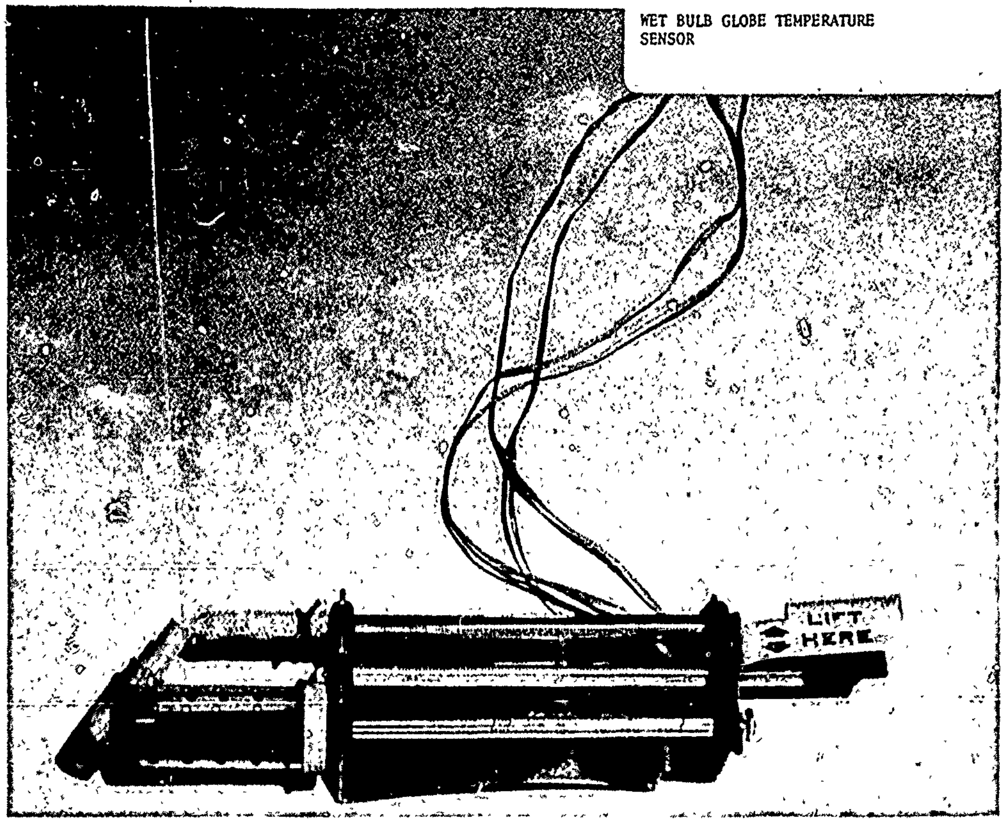


Photo 61.

APPENDIX F. DATA REDUCTION METHODS

VIBRATION DATA

1. Because of the discrete frequency content of the data, a narrow-band spectral analysis was performed. A Spectral Dynamics 301 real-time spectral analyzer was utilized to perform the spectral analysis. This spectral analysis converted the data from the time domain (acceleration as a function of time) to the frequency domain (acceleration as a function of frequency). The output of the spectral analysis was a digital plot of acceleration versus frequency composed of acceleration values at 500 discrete frequencies uniformly spaced over the selected frequency range of the spectrum analyzer. The data were analyzed over two frequency ranges: zero to 500 Hz for instruments, avionics, and the pilot station, and zero to 2000 Hz for all other locations with resolution bandwidths of 1 Hz and 4 Hz, respectively. The zero-to-500-Hz analysis range was utilized for all instruments, avionics, and pilot station data, since there were no data of interest above 500 Hz, and the frequency resolution was better on the 500-Hz range than on the 2000-Hz range. The zero-to-2000-Hz analysis range was used for all other locations, since there were significant data above 500 Hz and the maximum instrumentation frequency response was 2000 Hz. Because of the random variation in amplitude, the data were averaged over a period of time to determine the mean acceleration amplitude for each test condition. This data averaging was accomplished with a Spectral Dynamics 302B ensemble averager. Data were averaged over an 8-second time interval for steady-state nonweapons-firing flight conditions, a 2-second interval for maneuvering flight, and a 2-second interval for weapons firing. The 2-second maneuvering flight analysis time interval was selected to cover the most severe vibrations encountered during the maneuver.

2. The following equations were used to calculate the acceleration mean and standard deviation values:

a. Mean ($\overline{X}$):

$$\overline{X} = \frac{\sum_{j=1}^{N} X_j}{N}$$

b. Standard deviation (S):

$$S = \sqrt{\frac{\sum_{j=1}^{N} \left(X_j - \overline{X}\right)^2}{N}}$$

c. Mean plus standard deviation (Y):

$$Y = \overline{X} + S$$

Where: X_j = acceleration at a specific frequency

N = number of records compressed

3. Figures 1 and 2 are block diagrams of the spectral analysis and data compression procedures.

TEMPERATURE DATA

4. The electrical analogue shown in figure 3 was developed to predict the temperature of the cabin and avionics under static conditions at values of ambient air temperature and external radiation different than those tested. The results of this analysis are presented in figures 136 through 144, appendix G.

FIGURE 1
PROJECT 70-15 VIBRATION DATA
SPECTRAL ANALYSIS PROCEDURE

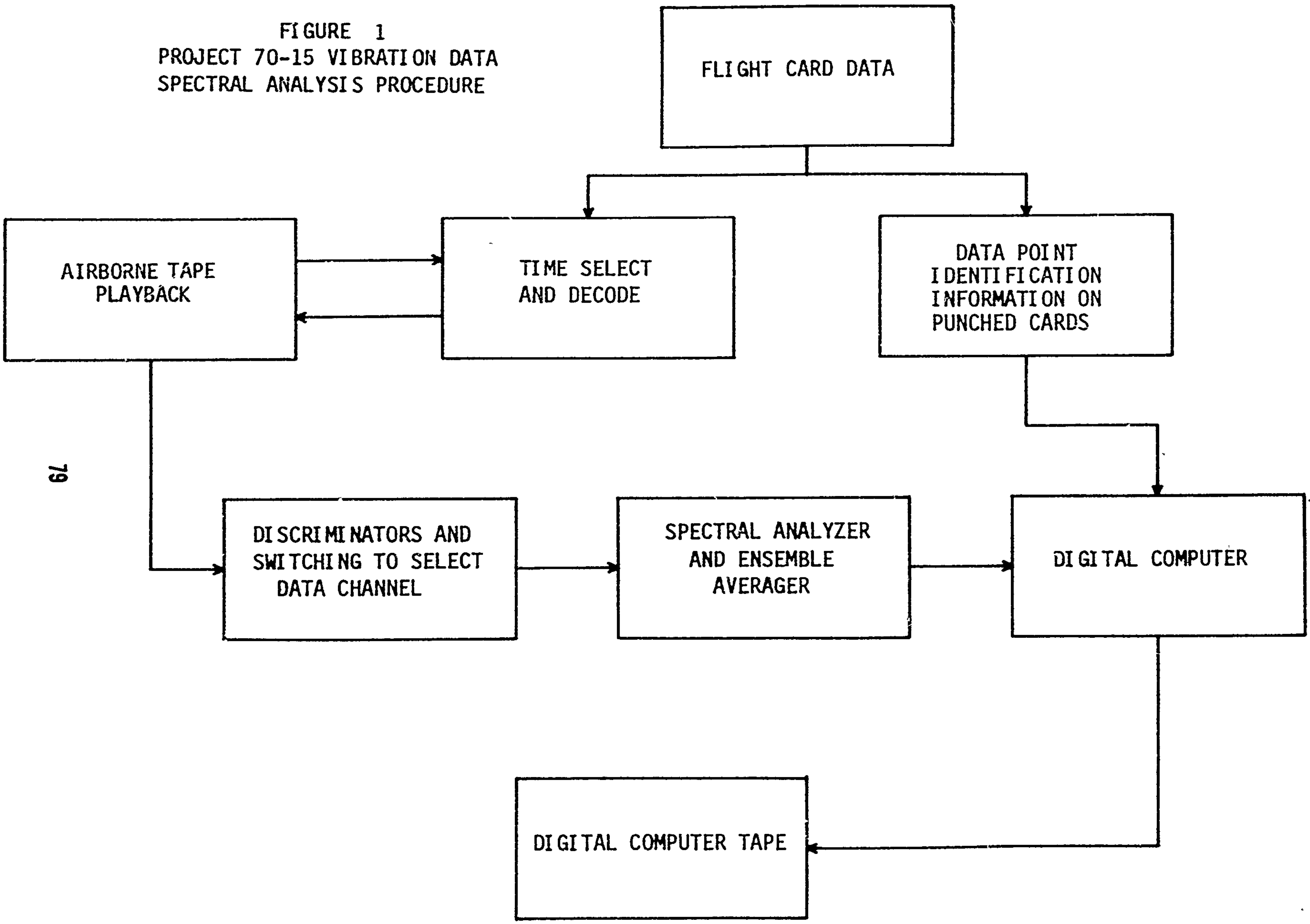
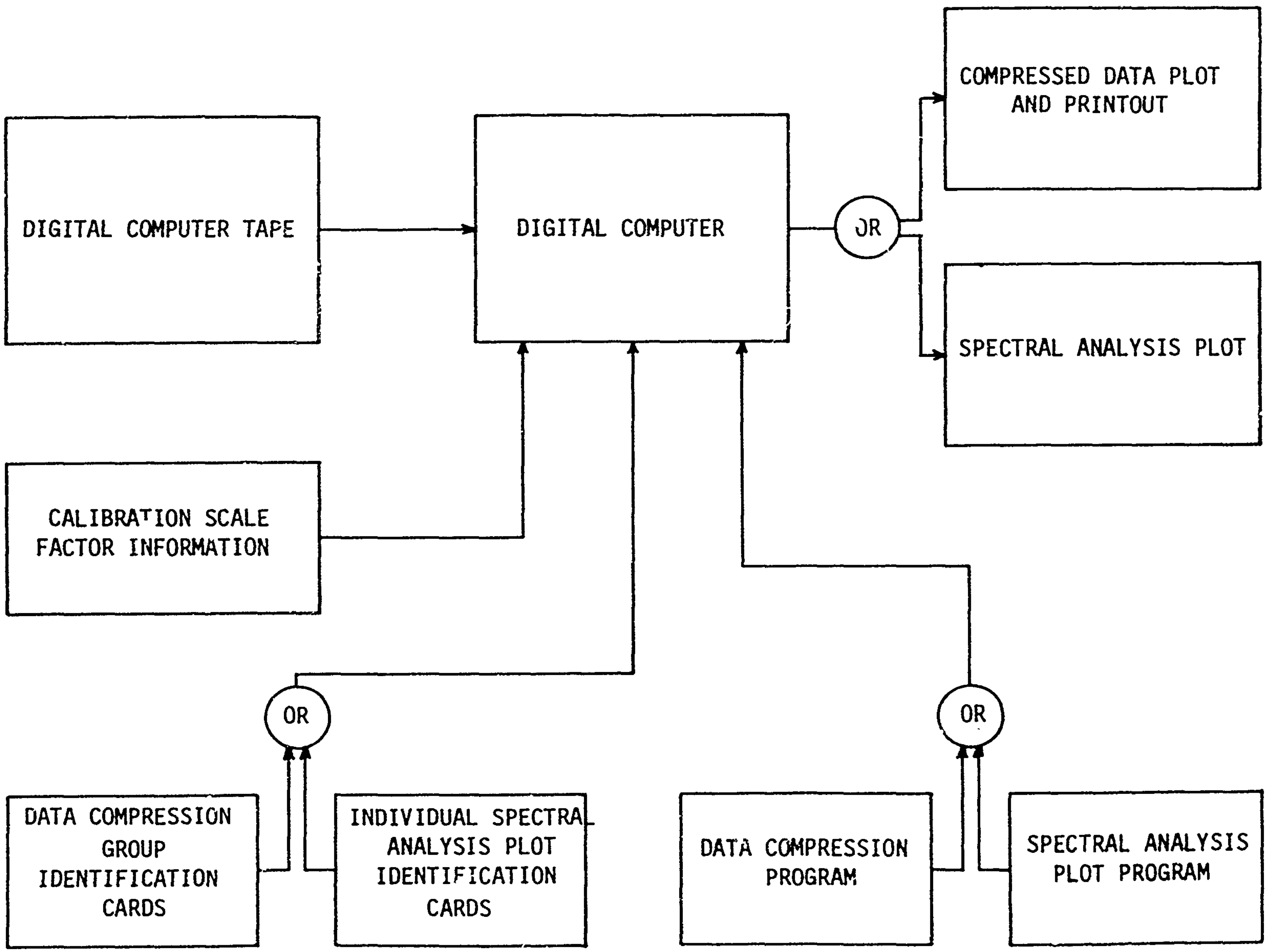


FIGURE 2
PROJECT 70-15 VIBRATION DATA
COMPRESSION PROCEDURE



ELECTRICAL QUANTITY	HEAT TRANSFER QUANTITY	UNIT (°K)
V ~ Voltage	T_a ~ Ambient air temperature	°K
V_c ~ Voltage across capacitor	T_c ~ Transient temperature inside helicopter	°K
	T_{ss} ~ Steady-state temperature inside helicopter	°K
	T_o ~ Initial temperature inside helicopter	°K
R_1 ~ Resistance	K_c ~ Conduction coefficient	Hr · °K/BTU
R_1 ~Resistance	K_r ~ Radiation heat transfer coefficient	Hr · °K/BTU
C ~ Capacitor	C ~ Heat capacity	BTU/°C
I ~ Current	E_{ex} ~ Total [illegible]ernal radiation	BTU/hr
	E_a ~ Atmospheric radiation (total external radiation minus solar radiation)	BTU/hr
	E_s ~ Solar radiation	BTU/hr
t ~ Time	t ~ Time	Hr

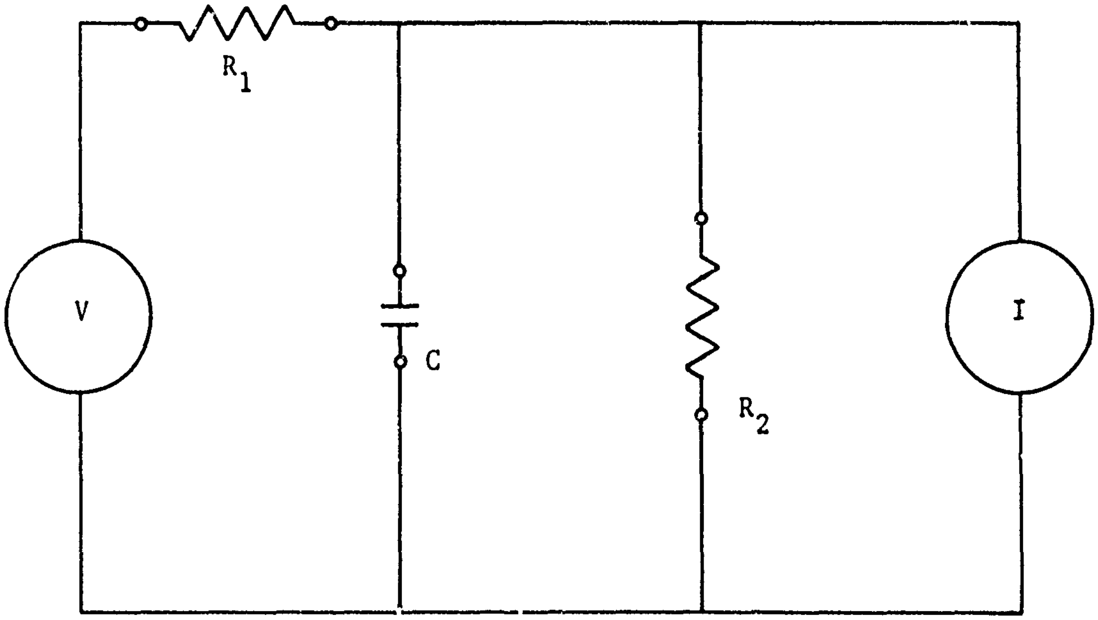


Figure 3. Heat Transfer Electrical Analog.

5. Using the circuit shown in figure 3, the equation describing the transient response of the helicopter to an ambient air temperature and source of external radiation can be written as:

$$T_c = e^{-t/K_{eq}C}\left[T_o - \frac{T_a K_r + E_{ex} K_c K_r}{K_c + K_r}\right] + \frac{T_a K_r + E_{ex} K_c K_r}{K_c + K_r} \quad (1)$$

Where: $K_{eq} = \dfrac{K_c \ K_r}{K_c + K_r}$

When t (time) → ∞ the steady-state helicopter temperature T_{ss} is given by:

Where: $$T_{ss} = \frac{T_a K_r + E_{ex} K_c K_r}{K + K} \quad (2)$$

$$E_{ex} = E_s + \sigma T_a^4$$

$$\sigma = 1.8 \times 10^{-8} \text{ BTU/ft}^2\text{-hour - °K}^4$$

6. Equation 2 was used to find K_c and K_r by allowing the helicopter to reach its steady-state temperature at two different constant ambient air temperatures (T_{a1} and T_{a2}) and at two different external radiation values (E_{ex1} and E_{ex2}). This resulted in two equations with two unknowns, K_c and K_r, which were solved for K_c and K_r, equations 3 and 4.

$$K_c = \frac{T_{a_2} T_{ss_1} - T_{a_1} T_{ss_2}}{E_{ex_1} T_{ss_2} - E_{ex_2} T_{ss_1}} \quad (3)$$

$$K_r = \frac{T_{ss_1} K_c}{T_{a_1} + E_{ex_1} K_c - T_{ss_1}} \quad (4)$$

7. A different K_c and K_r were calculated for each temperature sensor location. Each location was considered to comprise an area of 1 square foot which enabled the measured external radiation value in units of BTU/ft^2-hr to be converted to BTU/hr. These values of K_c and K_r were then inserted into equation 2 in order to calculate the steady-state temperature at each temperature sensor location for different values of solar radiation and ambient air temperature than those tested (figs. 136 through 144, app. G).

WET BULB GLOBE TEMPERATURE CALCULATION

8. The WBGT index is calculated from the following equation:

$$WBGT = 0.7WB + 0.2GT + 0.1DB$$

Where: WB = Naturally convected wet bulb temperature - °F

DB = Dry bulb temperature - °F

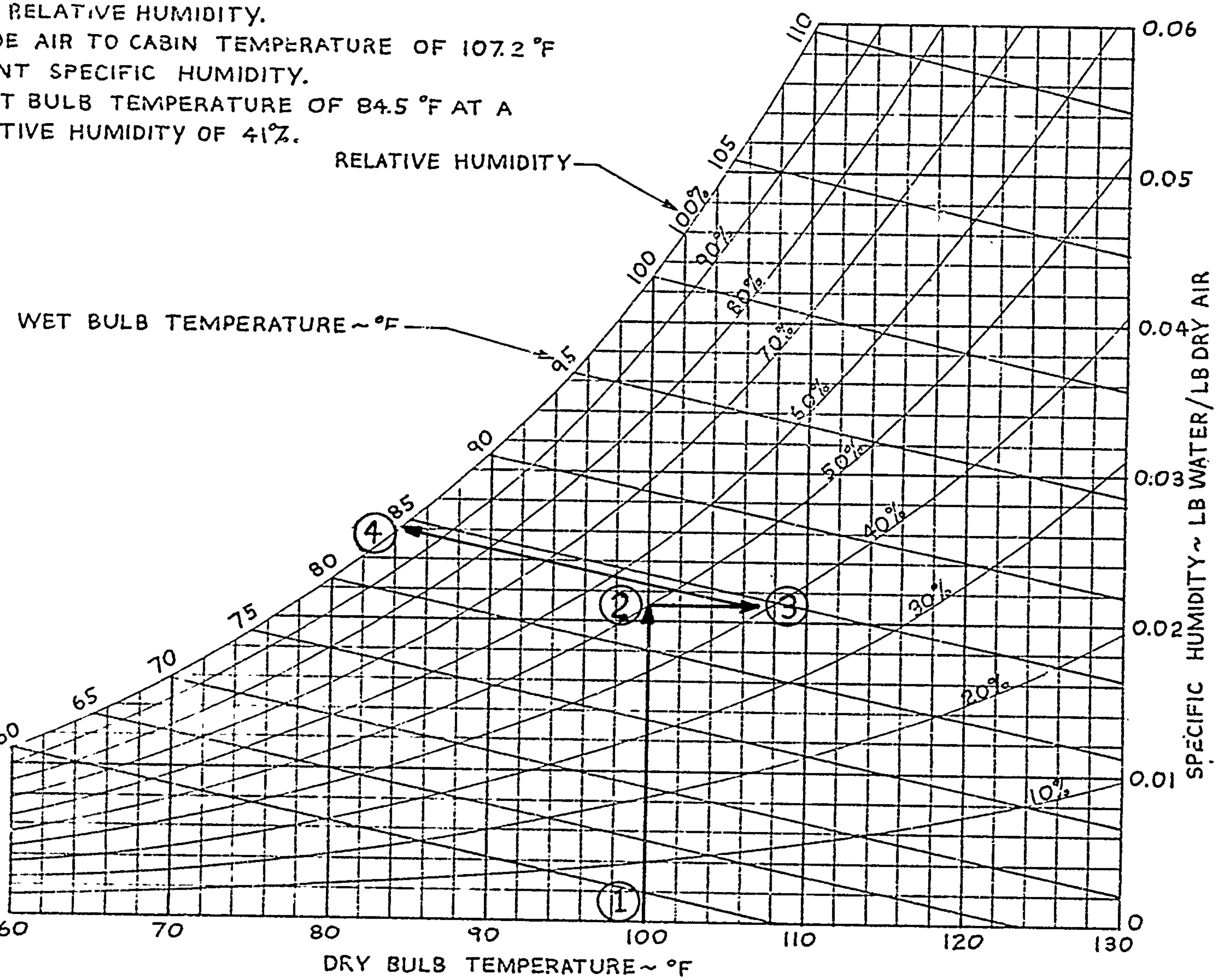
GT = Globe temperature - °F

For an outside air temperature of 100°F, a solar radiation value of 250 BTU/hr-ft^2 and an airspeed of 80 KCAS, a cabin temperature of 114.4°F and a globe tempera ..re of 124.8°F can be determined from figure G. At a relative humidity of 50 percent at 100°F, a psychrometric chart can be used to determine a wet bulb temperature of 86.5°F for a cabin dry bulb temperature of 114.4°F. Using these temperature values, the WBGT can be calculated.

$$WBGT = (0.7)(86.5) + (0.2)(124.8) + (0.1)(114.4) = 97.0°F$$

FIGURE 4
PSYCHROMETRIC CHART
BAROMETRIC PRESSURE 29.92 IN. Hg

1. ENTER CHART AT OUTSIDE AIR TEMPERATURE OF 100 °F.
2. GO TO 50% RELATIVE HUMIDITY.
3. HEAT OUTSIDE AIR TO CABIN TEMPERATURE OF 107.2 °F AT CONSTANT SPECIFIC HUMIDITY.
4. GO TO A WET BULB TEMPERATURE OF 84.5 °F AT A CABIN RELATIVE HUMIDITY OF 41%.



APPENDIX G. TEST DATA

Index

FIGURE 1

FIRST PASS DATA COMPRESSION ARRAY

CH-54B USA S/N 69-18463

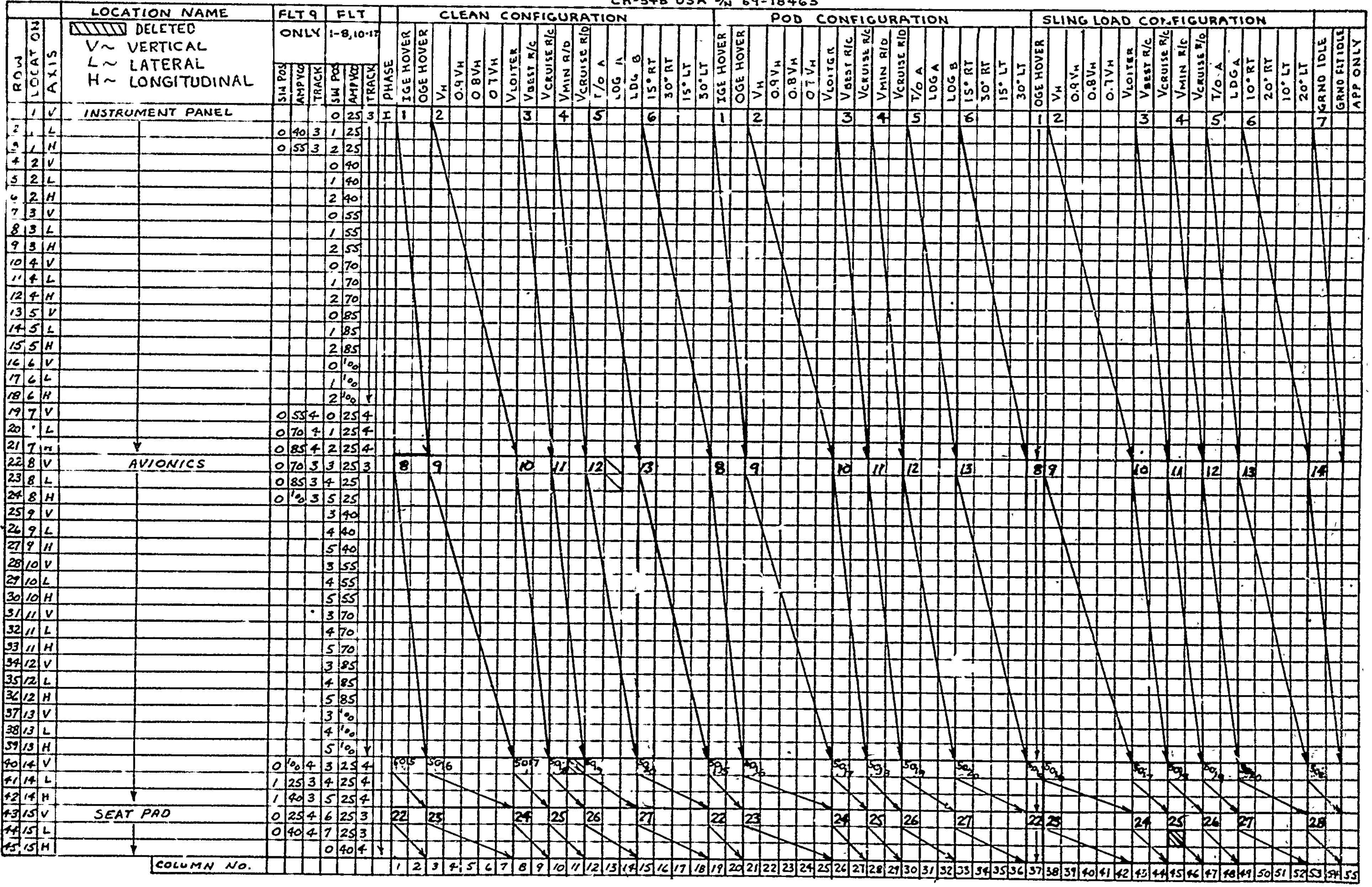


FIGURE 1
FIRST PASS DATA COMPRESSION ARRAY
CH-54B USA S/N 69-18463

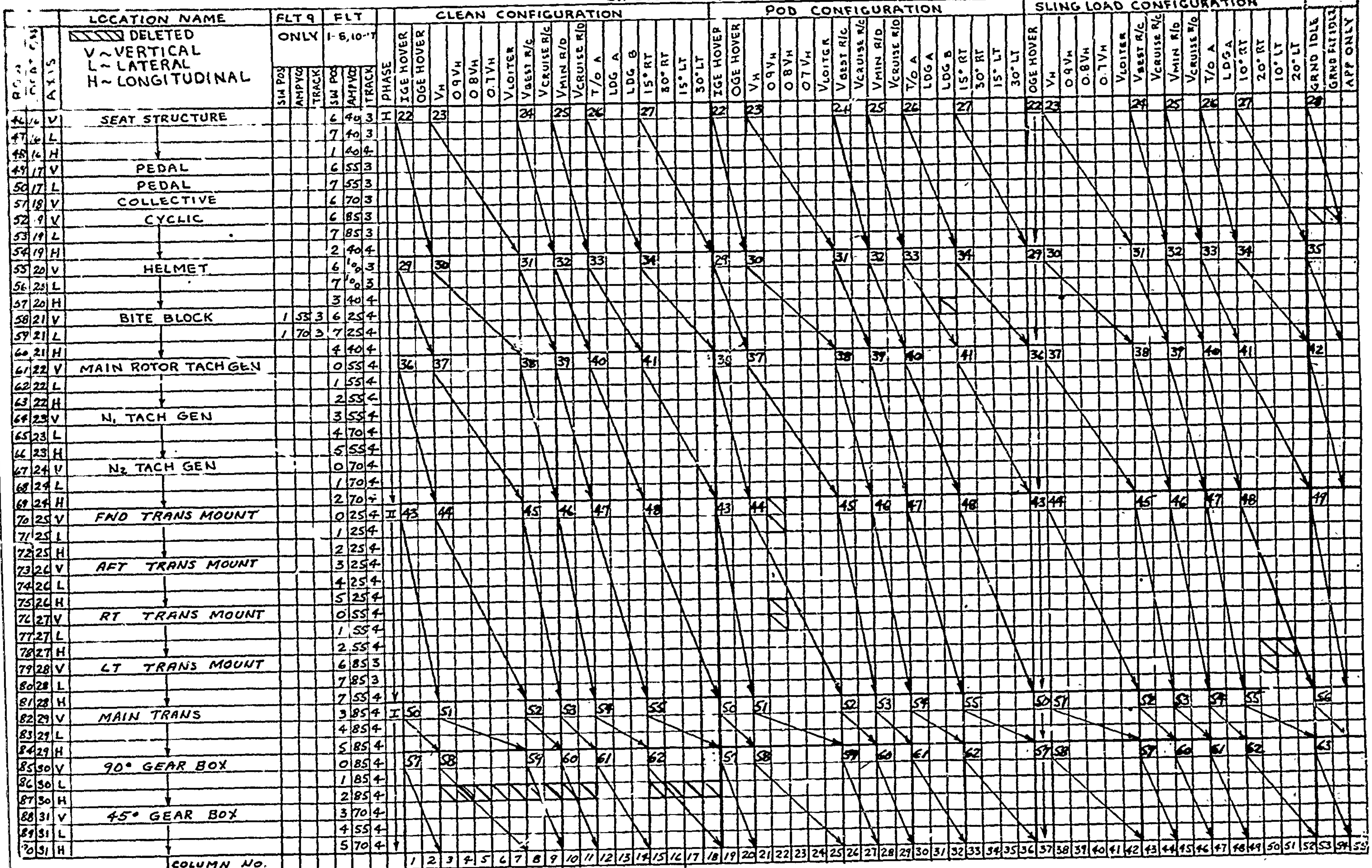


FIGURE 1
FIRST PASS DATA COMPRESSION ARRAY
CH-54B USA S/N 69-18463

LOCATION NAME: ▨ DELETED; V ~ VERTICAL; L ~ LATERAL; H ~ LONGITUDINAL

ROW	LOCATION	AXIS	LOCATION NAME	FLT 9 ONLY			FLT 1-8, 10-17				CLEAN CONFIGURATION																		POD CONFIGURATION																		SLING LOAD CONFIGURATION																		
				SW. POS	AMPVG	TRACK	SW POS	AMPVG	TRACK	PHASE	IGE HOVER	OGE HOVER	V_H	$0.9V_H$	$0.8V_H$	$0.7V_H$	V_{LOITER}	V_{BEST} R/C	V_{CRUISE} R/C	V_{MIN} R/D	V_{CRUISE} R/D	T/O A	LDG A	LDG B	15° RT	30° RT	15° LT	30° LT	IGE HOVER	OGE HOVER	V_H	$0.9V_H$	$0.8V_H$	$0.7V_H$	V_{LOITER}	V_{BEST} R/C	V_{CRUISE} R/C	V_{MIN} R/D	V_{CRUISE} R/D	T/O A	LDG A	LDG B	15° RT	30° RT	15° LT	30° LT	OGE HOVER	V_H	$0.9V_H$	$0.8V_H$	$0.7V_H$	V_{LOITER}	V_{BEST} R/C	V_{CRUISE} R/C	V_{MIN} R/D	V_{CRUISE} R/D	T/O A	LDG A	10° RT	20° RT	10° LT	20° LT	GRND IDLE	GRND FLT IDLE	APP ONLY
91	32	V	HANGER BEARING NO. 1				0	100	4	I	64		65					66		67		68			69				64		65					66		67		68			69				64	65					66		67		68		69				70		
92	32	L					1	100	4																																																							
93	33	V	HANGER BEARING NO. 2				6	70	4																																																							
94	33	L					7	70	4																																																							
95	34	V	HANGER BEARING NO. 3				6	85	4																																																							
96	34	L					7	85	4																																																							
97	35	V	HANGER BEARING NO. 4				6	100	4																																																							
98	35	L					7	100	4																																																							
99	36	V	HANGER BEARING NO. 5				6	25	4	II																																																						
100	36	L					7	25	4																																																							
101	37	V	HYDRAULIC PUMP (1st STAGE)				0	40	4		71		72					73		74		75			76				71		72					73		74		75			76				71	72					73		74		75		76				77		
102	37	L					1	40	4																																																							
103	37	H					2	40	4																																																							
104	38	V	HOIST HYDRAULIC LINE				3	55	4																																																							
105	38	L					4	55	4																																																							
106	38	H					5	55	4																																																							
107	39	V	HYDRAULIC MANIFOLD (2nd STAGE)				0	25	3																																																							
108	39	L					1	25	3																																																							
109	39	H					2	25	3																																																							
110	40	V	HYDRAULIC PUMP (UTILITY)				6	70	4																																																							
111	40	L					7	70	4																																																							
112	40	H					6	55	4																																																							
113	41	V	HYDRAULIC SLED				0	40	3																																																							
114	41	L					1	40	3																																																							
115	41	H					2	40	3																																																							
116	42	V	OIL COOLER SUPPORT				0	55	3		78		79					80		81		82			83				78		79					80		81		82			83				78	79					80		81		82		83				84		
117	42	L					1	55	3																																																							
118	42	H					2	55	3																																																							
119	43	V	OIL COOLER IDLER				3	55	3																																																							
120	43	L					4	55	3																																																							
121	43	H					5	55	3																																																							
122	44	V	APP FUEL PRESSURE SWITCH				0	85	3		85		86					87		88		89			90				85		86					87		88		89			90				85	86					87		88		89		90				91		
123	44	L					1	85	3																																																							
124	44	H					2	85	3																																																							
125	45	V	ENGINE FUEL PRESSURE SWITCH				0	100	3																																																							
126	45	L					1	100	3																																																							
127	45	H					2	100	3																																																							
128	46	V	BRAKE CYLINDER				3	25	3		92		93					94		95		96			97				92		93					94		95		96			97				92	93					94		95		96		97				98		
129	46	L					4	25	3																																																							
130	46	H					5	25	3																																																							
131	47	V	ROTOR BRAKE SUPPORT				3	40	3		99		100					101		102		103			104				99		100					101		102		103			104				99	100					101		102		103		104				105		
132	47	L					4	40	3																																																							
133	47	H					5	40	3																																																							
134	48	V	COMPASS SUPPORT				0	70	3		[illegible]		[illegible]					[illegible]		[illegible]		[illegible]			[illegible]				[illegible]		[illegible]					[illegible]		[illegible]		[illegible]			[illegible]				[illegible]	[illegible]					[illegible]		[illegible]		[illegible]		[illegible]				[illegible]		
135	48	L					1	70	3																																																							
			COLUMN NO.								1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55

FIGURE 1
FIRST PASS DATA COMPRESSION ARRAY
CH-54B USA S/N 69-18463

LOCATION NAME: DELETED (hatched); V ~ VERTICAL; L ~ LATERAL; H ~ LONGITUDINAL

ROW	LOCATION	AXIS	LOCATION NAME	FLT 9 ONLY SW POS	FLT 9 ONLY AMPVO	FLT 9 ONLY TRACK	FLT 1-8,10-17 SW POS	FLT 1-8,10-17 AMPVO	FLT 1-8,10-17 TRACK	PHASE
136	48	H	COMPASS SUPPORT				2	70	3	II
137	49	V	COCKPIT BLOWER				3	70	3	
138	49	L					4	70	3	
139	49	H					5	70	3	
140	50	V	HORIZONTAL STABILIZER				3	85	3	
141	50	L					4	85	3	
142	50	H					5	85	3	
143	51	V	ANTICOLLISON LIGHT				3	100	3	
144	51	L					4	100	3	
145	51	H					5	100	3	
146	52	V	SERVO ACTUATOR NO.1				0	70	4	
147	52	L					1	70	4	
148	52	H					2	70	4	
149	53	V	SERVO ACTUATOR NO.2				3	70	4	
150	53	L					4	70	4	
151	53	H					5	70	4	
152	54	V	AFSC SERVO				6	25	3	
153	54	L					7	25	3	
154	54	H					6	100	3	
155	55	V	HYDRAULIC MANIFOLD (1st STAGE)				6	70	3	
156	55	L					7	40	3	
157	55	H					7	100	3	
158	56	V	ADF ANTENNA MOUNT				4	40	4	I
159	56	L					7	40	4	
160	56	H					5	40	4	
161	57	V	APP CLUTCH				6	40	4	II
162	57	L					7	40	4	
163	57	H					5	40	4	
164	58	V	APP MOUNT				3	100	4	I
165	58	L					4	100	4	
166	58	H					5	100	4	
167	60	V	TORQUE TUBE				0	85	4	II
168	60	L						85	4	
169	61	V	OUTBOARD ABSORBER				2	85	4	
170	61	L					3	85	4	
171	62	V	INBOARD ABSORBER				4	85	4	
172	62	L					5	85	4	
173	63	V	OUTBOARD FWD MOUNT				6	85	4	
174	63	L					7	85	4	
175	64	V	INBOARD FWD MOUNT				0	100	4	
176	64	L					1	100	4	
177	65	V	POWER TURBINE TOP				2	100	4	
178	66	L	POWER TURBINE SIDE				3	100	4	
179	67	V	REAR FRAME TOP				4	100	4	
180	68	L	REAR FRAME SIDE				5	100	4	

COLUMN NO	Configuration	Condition
1	CLEAN CONFIGURATION	IGE HOVER
2	CLEAN CONFIGURATION	OGE HOVER
3	CLEAN CONFIGURATION	V_H
4	CLEAN CONFIGURATION	$0.9V_H$
5	CLEAN CONFIGURATION	$0.8V_H$
6	CLEAN CONFIGURATION	$0.7V_H$
7	CLEAN CONFIGURATION	V_{LOITER}
8	CLEAN CONFIGURATION	V_{BEST} R/C
9	CLEAN CONFIGURATION	V_{CRUISE} R/C
10	CLEAN CONFIGURATION	V_{MIN} R/D
11	CLEAN CONFIGURATION	V_{CRUISE} R/D
12	CLEAN CONFIGURATION	T/O A
13	CLEAN CONFIGURATION	LDG A
14	CLEAN CONFIGURATION	LDG B
15	CLEAN CONFIGURATION	15° RT
16	CLEAN CONFIGURATION	30° RT
17	CLEAN CONFIGURATION	15° LT
18	CLEAN CONFIGURATION	30° LT
19	POD CONFIGURATION	IGE HOVER
20	POD CONFIGURATION	OGE HOVER
21	POD CONFIGURATION	V_H
22	POD CONFIGURATION	$0.9V_H$
23	POD CONFIGURATION	$0.8V_H$
24	POD CONFIGURATION	$0.7V_H$
25	POD CONFIGURATION	V_{LOITER}
26	POD CONFIGURATION	V_{BEST} R/C
27	POD CONFIGURATION	V_{CRUISE} R/C
28	POD CONFIGURATION	V_{MIN} R/D
29	POD CONFIGURATION	V_{CRUISE} R/D
30	POD CONFIGURATION	T/O A
31	POD CONFIGURATION	LDG A
32	POD CONFIGURATION	LDG B
33	POD CONFIGURATION	15° RT
34	POD CONFIGURATION	30° RT
35	POD CONFIGURATION	15° LT
36	POD CONFIGURATION	30° LT
37	SLING LOAD CONFIGURATION	OGE HOVER
38	SLING LOAD CONFIGURATION	V_H
39	SLING LOAD CONFIGURATION	$0.9V_H$
40	SLING LOAD CONFIGURATION	$0.8V_H$
41	SLING LOAD CONFIGURATION	$0.7V_H$
42	SLING LOAD CONFIGURATION	V_{LOITER}
43	SLING LOAD CONFIGURATION	V_{BEST} R/C
44	SLING LOAD CONFIGURATION	V_{CRUISE} R/C
45	SLING LOAD CONFIGURATION	V_{MIN} R/D
46	SLING LOAD CONFIGURATION	V_{CRUISE} R/D
47	SLING LOAD CONFIGURATION	T/O A
48	SLING LOAD CONFIGURATION	LDG A
49	SLING LOAD CONFIGURATION	10° RT
50	SLING LOAD CONFIGURATION	20° RT
51	SLING LOAD CONFIGURATION	10° LT
52	SLING LOAD CONFIGURATION	20° LT
53		GRND IDLE
54		GRND FLT IDLE
55		APP ONLY

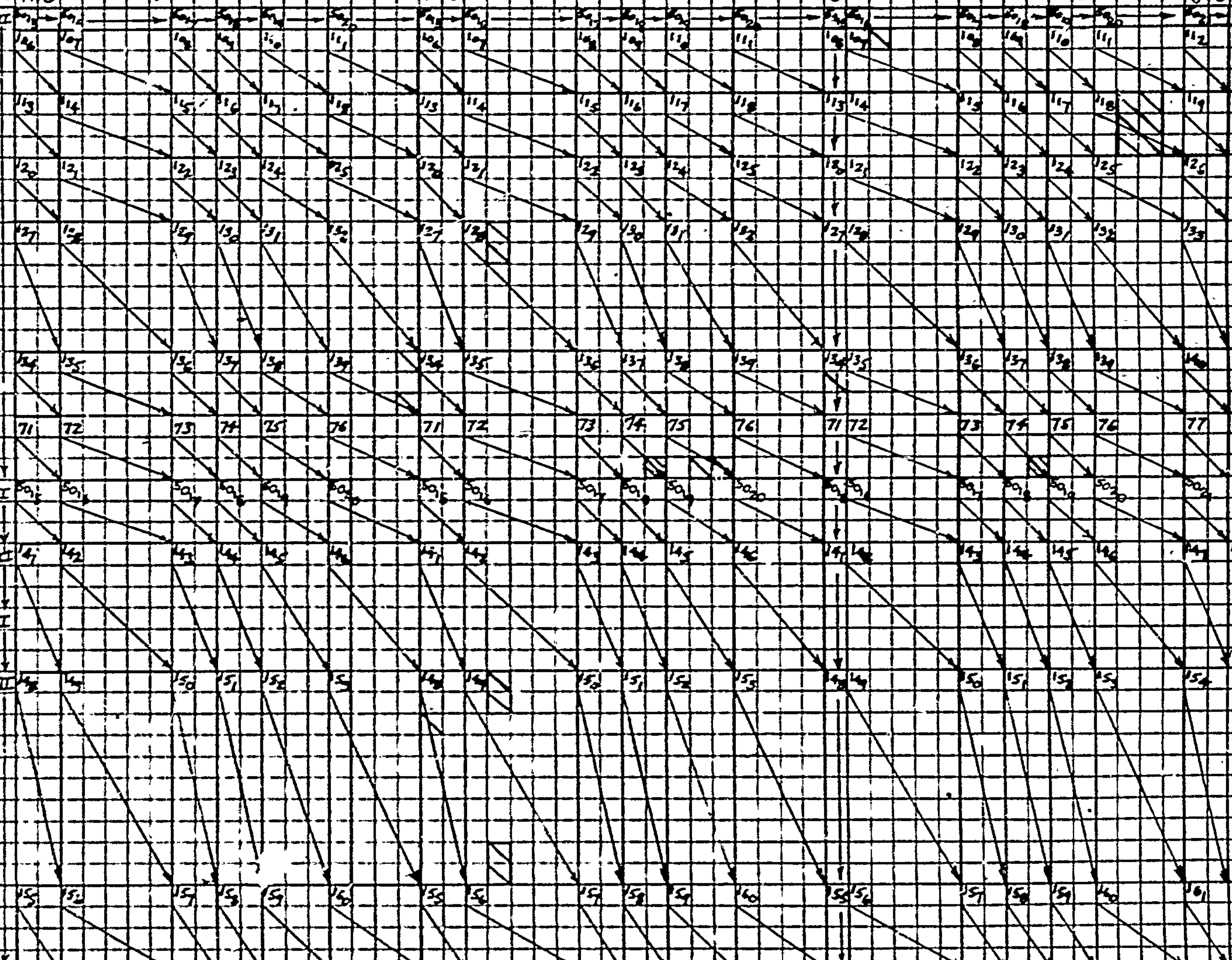


FIGURE 1
FIRST PASS DATA COMPRESSION ARRAY
CH-54B USA S/N 69-18463

LOCATION NAME: (hatched) DELETED; V ~ VERTICAL; L ~ LATERAL; H ~ LONGITUDINAL

ROW	LOCATION	AXIS	LOCATION NAME	FLT 9 ONLY SW.POS	FLT 9 ONLY AMP.VCO	FLT 9 ONLY TRACK	FLT 1-8,10-17 SW.POS	FLT 1-8,10-17 AMP.VCO	FLT 1-8,10-17 TRACK	PHASE
81	69	V	FRONT FRAME TOP				6	100	4	II
82	70	L	FRONT FRAME SIDE				7	100	4	II

CLEAN CONFIGURATION

ROW	IGE HOVER	OGE HOVER	V_H	$0.9V_H$	$0.8V_H$	$0.7V_H$	V_{LOITER}	$V_{BEST\ R/C}$	$V_{CRUISE\ R/C}$	$V_{MIN\ R/D}$	$V_{CRUISE\ R/D}$	T/O A	LDG A	LDG B	15° RT	30° RT	15° LT	30° LT
81	155		156					157		158		159			160			
82																		
COLUMN NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

POD CONFIGURATION

ROW	IGE HOVER	OGE HOVER	V_H	$0.9V_H$	$0.8V_H$	$0.7V_H$	V_{LOITER}	$V_{BEST\ R/C}$	$V_{CRUISE\ R/C}$	$V_{MIN\ R/D}$	$V_{CRUISE\ R/D}$	T/O A	LDG A	LDG B	15° RT	30° RT	15° LT	30° LT
81	155		156					157		158		159			160			
82																		
COLUMN NO.	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36

SLING LOAD CONFIGURATION

ROW	OGE HOVER	V_H	$0.9V_H$	$0.8V_H$	$0.7V_H$	V_{LOITER}	$V_{BEST\ R/C}$	$V_{CRUISE\ R/C}$	$V_{MIN\ R/D}$	$V_{CRUISE\ R/D}$	T/O A	LDG A	10° RT	20° RT	10° LT	20° LT	GRND IDLE	GRND FLT.IDLE	APP.ONLY
81	155	156					157		158		159		160				161		
82																			
COLUMN NO.	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55

FIGURE 2
SECOND PASS DATA COMPRESSION ARRAY
CH-54B USA S/N 69-18463

LOCATION NAME: ▨ DELETED; V ~ VERTICAL; L ~ LATERAL; H ~ LONGITUDINAL

ROW	LOCATION	AXIS	LOCATION NAME	FLT 9 ONLY SW. POS	FLT 9 ONLY AMPYG	FLT 9 ONLY TRACK	FLT 1-8,10-17 SW POS	FLT 1-8,10-17 AMPYG	FLT 1-8,10-17 TRACK	PHASE	CLEAN CONFIGURATION IGE HOVER	CLEAN OGE HOVER	CLEAN V_H	CLEAN $0.9V_H$	CLEAN $0.8V_H$	CLEAN $0.7V_H$	CLEAN V_{LOITER}	CLEAN V_{BEST} R/C	CLEAN V_{CRUISE} R/C	CLEAN V_{MIN} R/D	CLEAN V_{CRUISE} R/D	CLEAN T/O A	CLEAN LDG A	CLEAN LDG B	CLEAN 15° RT	CLEAN 30° RT	CLEAN 15° LT	CLEAN 30° LT	POD CONFIGURATION IGE HOVER	POD OGE HOVER	POD V_H	POD $0.9V_H$	POD $0.8V_H$	POD $0.7V_H$	POD V_{LOITER}	POD V_{BEST} R/C	POD V_{CRUISE} R/C	POD V_{MIN} R/D	POD V_{CRUISE} R/D	POD T/O A	POD LDG A	POD LDG B	POD 15° RT	POD 30° RT	POD 15° LT	POD 30° LT	SLING LOAD CONFIGURATION OGE HOVER	SLING V_H	SLING $0.9V_H$	SLING $0.8V_H$	SLING $0.7V_H$	SLING V_{LOITER}	SLING V_{BEST} R/C	SLING V_{CRUISE} R/C	SLING V_{MIN} R/D	SLING V_{CRUISE} R/D	SLING T/O A	SLING LDG A	SLING 10° RT	SLING 20° RT	SLING 10° LT	SLING 20° LT	GRND IDLE	LAND FLT IDLE	APP ONLY
1	1	V	INSTRUMENT PANEL				0	25	3	I	1/4																																																						
2	1	L		0	40	3	1	25																																																									
3	1	H		0	55	3	2	25																																																									
4	2	V					0	40																																																									
5	2	L					1	40																																																									
6	2	H					2	40																																																									
7	3	V					0	55																																																									
8	3	L					1	55																																																									
9	3	H					2	55																																																									
10	4	V					0	70																																																									
11	4	L					1	70																																																									
12	4	H					2	70																																																									
13	5	V					0	85																																																									
14	5	L					1	85																																																									
15	5	H					2	85																																																									
16	6	V					0	100																																																									
17	6	L					1	100																																																									
18	6	H					2	100																																																									
19	7	V		0	55	4	0	25	4																																																								
20	7	L		0	70	4	1	25	4																																																								
21	7	H		0	85	4	2	25	4																																																								
22	8	V	AVIONICS	0	70	3	3	25	3		1/2																																																						
23	8	L		0	85	3	4	25																																																									
24	8	H		0	100	3	5	25																																																									
25	9	V					3	40																																																									
26	9	L					4	40																																																									
27	9	H					5	40																																																									
28	10	V					3	55																																																									
29	10	L					4	55																																																									
30	10	H					5	55																																																									
31	11	V					3	70																																																									
32	11	L					4	70																																																									
33	11	H					5	70																																																									
34	12	V					3	85																																																									
35	12	L					4	85																																																									
36	12	H					5	85																																																									
37	13	V					3	100																																																									
38	13	L					4	100																																																									
39	13	H					5	100																																																									
40	14	V		0	100	4	3	25	4		5/2																																																						
41	14	L		1	25	3	4	25	4																																																								
42	14	H		1	40	3	5	25	4																																																								
43	15	V	SEAT PAD	0	25	4	6	25	3		1/4																																																						
44	15	L		0	40	4	7	25	3																																																								
45	15	H					0	40	4																																																								
			COLUMN NO.								1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55

FIGURE 2
SECOND PASS DATA COMPRESSION ARRAY
CH-54B USA S/N 69-18463

LOCATION NAME
DELETED (hatched)
V ~ VERTICAL
L ~ LATERAL
H ~ LONGITUDINAL

ROW	LOCATION	AXIS	LOCATION NAME	FLT 9 ONLY SW POS	FLT 9 ONLY AMPVD	FLT 9 ONLY TRACK	FLT 1-8,10-17 SW POS	FLT 1-8,10-17 AMPVD	FLT 1-8,10-17 TRACK	PHASE	IGE HOVER (1)
46	16	V	SEAT STRUCTURE				6	40	3	I	6₁
47	16	L	↓				7	40	3		
48	16	H					1	40	4		
49	17	V	PEDAL				6	55	3		
50	17	L	PEDAL				7	55	3		
51	18	V	COLLECTIVE				6	70	3		
52	19	V	CYCLIC				6	85	3		
53	19	L	↓				7	85	3		
54	19	H					2	40	4		
55	20	V	HELMET				6	18	3		6₈
56	20	L	↓				7	18	3		
57	20	H					3	40	4		
58	21	V	BITE BLOCK	1	55	3	6	25	4		
59	21	L	↓	1	70	3	7	25	4		
60	21	H					4	40	4		
61	22	V	MAIN ROTOR TACH GEN				0	55	4		6₄
62	22	L	↓				1	55	4		
63	22	H					2	55	4		
64	23	V	N_1 TACH GEN				3	55	4		
65	23	L	↓				4	70	4		
66	23	H					5	55	4		
67	24	V	N_2 TACH GEN				0	70	4		
68	24	L	↓				1	70	4		
69	24	H					2	70	4		
70	25	V	FWD TRANS MOUNT				0	25	4	II	7₀
71	25	L	↓				1	25	4		
72	25	H					2	25	4		
73	26	V	AFT TRANS MOUNT				3	25	4		
74	26	L	↓				4	25	4		
75	26	H					5	25	4		
76	27	V	RT TRANS MOUNT				0	55	4		
77	27	L	↓				1	55	4		
78	27	H					2	55	4		
79	28	V	LT TRANS MOUNT				6	85	3		
80	28	L	↓				7	85	3		
81	28	H					7	55	4	II	
82	29	V	MAIN TRANS				3	85	4	I	7₁
83	29	L	↓				4	85	4		
84	29	H					5	85	4		
85	30	V	90° GEAR BOX				0	85	4		7₂
86	30	L	↓				1	85	4		
87	30	H					2	85	4		
88	31	V	45° GEAR BOX				3	70	4		
89	31	L	↓				4	55	4		
90	31	H					5	70	4		

CLEAN CONFIGURATION: 1 IGE HOVER, 2 OGE HOVER, 3 V_H, 4 $0.9V_H$, 5 $0.8V_H$, 6 $0.7V_H$, 7 V_{LOITER}, 8 $V_{BEST\ R/C}$, 9 $V_{CRUISE\ R/C}$, 10 $V_{MIN\ R/D}$, 11 $V_{CRUISE\ R/D}$, 12 T/O A, 13 LDG A, 14 LDG B, 15 15° RT, 16 30° RT, 17 15° LT, 18 30° LT

POD CONFIGURATION: 19 IGE HOVER, 20 OGE HOVER, 21 V_H, 22 $0.9V_H$, 23 $0.8V_H$, 24 $0.7V_H$, 25 V_{LOITER}, 26 $V_{BEST\ R/C}$, 27 $V_{CRUISE\ R/C}$, 28 $V_{MIN\ R/D}$, 29 $V_{CRUISE\ R/D}$, 30 T/O A, 31 LDG A, 32 LDG B, 33 15° RT, 34 30° RT, 35 15° LT, 36 30° LT

SLING LOAD CONFIGURATION: 37 OGE HOVER, 38 V_H, 39 $0.9V_H$, 40 $0.8V_H$, 41 $0.7V_H$, 42 V_{LOITER}, 43 $V_{BEST\ R/C}$, 44 $V_{CRUISE\ R/C}$, 45 $V_{MIN\ R/D}$, 46 $V_{CRUISE\ R/D}$, 47 T/O A, 48 LDG A, 49 10° RT, 50 20° RT, 51 10° LT, 52 20° LT

53 GRND IDLE, 54 GRND FLT IDLE, 55 APP ONLY

COLUMN NO.

FIGURE 2
SECONDPASS DATA COMPRESSION ARRAY
CH-54B USA S/N 69-18463

LOCATION NAME: ▨ DELETED; V ~ VERTICAL; L ~ LATERAL; H ~ LONGITUDINAL

ROW	LOCAT ON	AXIS	LOCATION NAME	FLT 9 ONLY SW POS	FLT 9 ONLY AMPVG	FLT 9 ONLY TRACK	FLT 1-8,10-17 SW POS	FLT 1-8,10-17 AMPVG	FLT 1-8,10-17 TRACK	PHASE	IGE HOVER (1)
91	32	V	HANGER BEARING NO. 1				0	100	4	I	17₃
92	32	L	↓				1	100	4		
93	33	V	HANGER BEARING No2				6	70	4		
94	33	L	↓				7	70	4		
95	34	V	HANGER BEARING No.3				6	85	4		
96	34	L	↓				7	85	4		
97	35	V	HANGER BEARING No 4				6	100	4		
98	35	L	↓				7	100	4	↓	
99	36	V	HANGER BEARING No.5				6	25	4	II	
100	36	L	↓				7	25	4		
101	37	V	HYDRAULIC PUMP (1ST STAGE)				0	40	4		17₄
102	37	L					1	40	4		
103	37	H	↓				2	40	4		
104	38	V	HOIST HYDRAULIC LINE				3	55	4		
105	38	L					4	55	4		
106	38	H	↓				5	55	4		
107	39	V	HYDRAULIC MANIFOLD (2ND STAGE)				0	25	3		
108	39	L					1	25	3		
109	39	H	↓				2	25	3		
110	40	V	HYDRAULIC PUMP (UTILITY)				6	70	4		
111	40	L					7	70	4		
112	40	H	↓				6	55	4		
113	41	V	HYDRAULIC SLED				0	40	3		
114	41	L					1	40	3		
115	41	H	↓				2	40	3		
116	42	V	OIL COOLER SUPPORT				0	55	3		17₅
117	42	L					1	55	3		
118	42	H	↓				2	55	3		
119	43	V	OIL COOLER IDLER				3	55	3		
120	43	L					4	55	3		
121	43	H	↓				5	55	3		
122	44	V	APP FUEL PRESSURE SWITCH				0	85	3		17₆
123	44	L					1	85	3		
124	44	H	↓				2	85	3		
125	45	V	ENGINE FUEL PRESSURE SWITCH				0	100	3		
126	45	L					1	100	3		
127	45	H	↓				2	100	3		
128	46	V	BRAKE CYLINDER				3	25	3		17₇
129	46	L					4	25	3		
130	46	H	↓				5	25	3		
131	47	V	ROTOR BRAKE SUPPORT				3	40	3		17₈
132	47	L					4	40	3		
133	47	H	↓				5	40	3		
134	48	V	COMPASS SUPPORT				0	70	3		1022
135	48	L	↓				1	70	3	↓	

COLUMN NO.	CONFIGURATION	CONDITION
1	CLEAN CONFIGURATION	IGE HOVER
2	CLEAN CONFIGURATION	OGE HOVER
3	CLEAN CONFIGURATION	V_H
4	CLEAN CONFIGURATION	$0.9V_H$
5	CLEAN CONFIGURATION	$0.8V_H$
6	CLEAN CONFIGURATION	$0.7V_H$
7	CLEAN CONFIGURATION	V_{LOITER}
8	CLEAN CONFIGURATION	V_{BEST} R/C
9	CLEAN CONFIGURATION	V_{CRUISE} R/C
10	CLEAN CONFIGURATION	V_{MIN} R/D
11	CLEAN CONFIGURATION	V_{CRUISE} R/D
12	CLEAN CONFIGURATION	T/O A
13	CLEAN CONFIGURATION	LDG A
14	CLEAN CONFIGURATION	LDG B
15	CLEAN CONFIGURATION	15° RT
16	CLEAN CONFIGURATION	30° RT
17	CLEAN CONFIGURATION	15° LT
18	CLEAN CONFIGURATION	30° LT
19	POD CONFIGURATION	IGE HOVER
20	POD CONFIGURATION	OGE HOVER
21	POD CONFIGURATION	V_H
22	POD CONFIGURATION	$0.9V_H$
23	POD CONFIGURATION	$0.8V_H$
24	POD CONFIGURATION	$0.7V_H$
25	POD CONFIGURATION	V_{LOITER}
26	POD CONFIGURATION	V_{BEST} R/C
27	POD CONFIGURATION	V_{CRUISE} R/C
28	POD CONFIGURATION	V_{MIN} R/D
29	POD CONFIGURATION	V_{CRUISE} R/D
30	POD CONFIGURATION	T/O A
31	POD CONFIGURATION	LDG A
32	POD CONFIGURATION	LDG B
33	POD CONFIGURATION	15° RT
34	POD CONFIGURATION	30° RT
35	POD CONFIGURATION	15° LT
36	POD CONFIGURATION	30° LT
37	SLING LOAD CONFIGURATION	OGE HOVER
38	SLING LOAD CONFIGURATION	V_H
39	SLING LOAD CONFIGURATION	$0.9V_H$
40	SLING LOAD CONFIGURATION	$0.8V_H$
41	SLING LOAD CONFIGURATION	$0.7V_H$
42	SLING LOAD CONFIGURATION	V_{LOITER}
43	SLING LOAD CONFIGURATION	V_{BEST} R/C
44	SLING LOAD CONFIGURATION	V_{CRUISE} R/C
45	SLING LOAD CONFIGURATION	V_{MIN} R/D
46	SLING LOAD CONFIGURATION	V_{CRUISE} R/D
47	SLING LOAD CONFIGURATION	T/O A
48	SLING LOAD CONFIGURATION	LDG A
49	SLING LOAD CONFIGURATION	10° RT
50	SLING LOAD CONFIGURATION	20° RT
51	SLING LOAD CONFIGURATION	10° LT
52	SLING LOAD CONFIGURATION	20° LT
53		GRND IDLE
54		GRND FLT IDLE
55		APP ONLY

FIGURE 2
SECONDPASS DATA COMPRESSION ARRAY
CH-54B USA S/N 69-18463

LOCATION NAME: (hatched box) DELETED; V ~ VERTICAL; L ~ LATERAL; H ~ LONGITUDINAL

ROW	LOCATION	AXIS	LOCATION NAME	FLT 9 ONLY SW.POS	FLT 9 ONLY AMPYD	FLT 9 ONLY TRACK	FLT 1-8,10-17 SW POS	FLT 1-8,10-17 AMPYD	FLT 1-8,10-17 TRACK	PHASE	IGE HOVER (1)
136	48	H	COMPASS SUPPORT				2	70	3	II	5022
137	49	V	COCKPIT BLOWER				3	70	3		174
138	49	L					4	70	3		
139	49	H					5	70	3		
140	50	V	HORIZONTAL STABILIZER				3	85	3		180
141	50	L					4	85	3		
142	50	H					5	85	3		
143	51	V	ANTI COLLISION LIGHT				3	100	3		181
144	51	L					4	100	3		
145	51	H					5	100	3		
146	52	V	SERVO ACTUATOR No. 1				0	70	4		182
147	52	L					1	70	4		
148	52	H					2	70	4		
149	53	V	SERVO ACTUATOR No. 2				3	70	4		
150	53	L					4	70	4		
151	53	H					5	70	4		
152	54	V	AESC SERVO				6	25	3		183
153	54	L					7	25	3		
154	54	H					6	100	3		
155	55	V	HYDRAULIC MANIFOLD (1st STAGE)				6	70	3		174
156	55	L					7	40	3		
157	55	H					7	100	3		
158	56	V	ADF ANTENNA ~~MOUNT~~				6	40	4	I	5022
159	56	L					7	40	4		
160	56	H					5	40	4		
161	57	V	APP CLUTCH				6	40	4	II	184
162	57	L					7	40	4		
163	57	H					5	40	4		
164	58	V	APP MOUNT				3	100	4	I	
165	58	L					4	100	4		
166	58	H					5	100	4		
167	60	V	TORQUE TUBE				0	85	4	II	185
168	60	L					1	85	4		
169	61	V	OUTBOARD ABSORBER				2	85	4		
170	61	L					3	85	4		
171	62	V	INBOARD ABSORBER				4	85	4		
172	62	L					5	85	4		
173	63	V	OUTBOARD FWD MOUNT				6	85	4		
174	63	L					7	85	4		
175	64	V	INBOARD FWD MOUNT				0	100	4		
176	64	L					1	100	4		
177	65	V	POWER TURBINE TOP				2	100	4		186
178	66	L	POWER TURBINE SIDE				3	100	4		
179	67	V	REAR FRAME TOP				4	100	4		
180	68	L	REAR FRAME SIDE				5	100	4		

COLUMN NO.	CONFIGURATION	CONDITION
1	CLEAN CONFIGURATION	IGE HOVER
2	CLEAN CONFIGURATION	OGE HOVER
3	CLEAN CONFIGURATION	V_H
4	CLEAN CONFIGURATION	$0.9V_H$
5	CLEAN CONFIGURATION	$0.8V_H$
6	CLEAN CONFIGURATION	$0.7V_H$
7	CLEAN CONFIGURATION	V_{LOITER}
8	CLEAN CONFIGURATION	V_{BEST} R/C
9	CLEAN CONFIGURATION	V_{CRUISE} R/C
10	CLEAN CONFIGURATION	V_{MIN} R/D
11	CLEAN CONFIGURATION	V_{CRUISE} R/D
12	CLEAN CONFIGURATION	T/O A
13	CLEAN CONFIGURATION	LDG A
14	CLEAN CONFIGURATION	LDG B
15	CLEAN CONFIGURATION	15° RT
16	CLEAN CONFIGURATION	30° RT
17	CLEAN CONFIGURATION	15° LT
18	CLEAN CONFIGURATION	30° LT
19	POD CONFIGURATION	IGE HOVER
20	POD CONFIGURATION	OGE HOVER
21	POD CONFIGURATION	V_H
22	POD CONFIGURATION	$0.9V_H$
23	POD CONFIGURATION	$0.8V_H$
24	POD CONFIGURATION	$0.7V_H$
25	POD CONFIGURATION	V_{LOITER}
26	POD CONFIGURATION	V_{BEST} R/C
27	POD CONFIGURATION	V_{CRUISE} R/C
28	POD CONFIGURATION	V_{MIN} R/D
29	POD CONFIGURATION	V_{CRUISE} R/D
30	POD CONFIGURATION	T/O A
31	POD CONFIGURATION	LDG A
32	POD CONFIGURATION	LDG B
33	POD CONFIGURATION	15° RT
34	POD CONFIGURATION	30° RT
35	POD CONFIGURATION	15° LT
36	POD CONFIGURATION	30° LT
37	SLING LOAD CONFIGURATION	OGE HOVER
38	SLING LOAD CONFIGURATION	V_H
39	SLING LOAD CONFIGURATION	$0.9V_H$
40	SLING LOAD CONFIGURATION	$0.8V_H$
41	SLING LOAD CONFIGURATION	$0.7V_H$
42	SLING LOAD CONFIGURATION	V_{LOITER}
43	SLING LOAD CONFIGURATION	V_{BEST} R/C
44	SLING LOAD CONFIGURATION	V_{CRUISE} R/C
45	SLING LOAD CONFIGURATION	V_{MIN} R/D
46	SLING LOAD CONFIGURATION	V_{CRUISE} R/D
47	SLING LOAD CONFIGURATION	T/O A
48	SLING LOAD CONFIGURATION	LDG A
49	SLING LOAD CONFIGURATION	10° RT
50	SLING LOAD CONFIGURATION	20° RT
51	SLING LOAD CONFIGURATION	10° LT
52	SLING LOAD CONFIGURATION	20° LT
53		GRND IDLE
54		GRND FLT IDLE
55		APP ONLY

FIGURE 3
THIRD PASS DATA COMPRESSION ARRAY
CH-54B USA S/N 69-18463

V ~ VERTICAL
L ~ LATERAL
H ~ LONGITUDINAL
DELETED

ROW	LOCATION	AXIS	LOCATION NAME	FLT 9 ONLY SH. POS	FLT 9 ONLY AMP/VID	FLT 9 ONLY TRACK	FLT 1-8,10-17 SW POS	FLT 1-8,10-17 AMP/VID	FLT 1-8,10-17 TRACK	PHASE
1	1	V	INSTRUMENT PANEL				0	25	3	I
2	1	L		0	40	3	1	25		
3	1	H		0	55	3	2	25		
4	2	V					0	40		
5	2	L					1	40		
6	2	H					2	40		
7	3	V					0	55		
8	3	L					1	55		
9	3	H					2	55		
10	4	V					0	70		
11	4	L					1	70		
12	4	H					2	70		
13	5	V					0	85		
14	5	L					1	85		
15	5	H					2	85		
16	6	V					0	100		
17	6	L					1	100		
18	6	H					2	100		
19	7	V		0	55	4	0	25	4	
20	7	L		0	70	4	1	25	4	
21	7	H		0	85	4	2	25	4	
22	8	V	AVIONICS	0	70	3	3	25	3	
23	8	L		0	85	3	4	25		
24	8	H		0	100	3	5	25		
25	9	V					3	40		
26	9	L					4	40		
27	9	H					5	40		
28	10	V					3	55		
29	10	L					4	55		
30	10	H					5	55		
31	11	V					3	70		
32	11	L					4	70		
33	11	H					5	70		
34	12	V					3	85		
35	12	L					4	85		
36	12	H					5	85		
37	13	V					3	100		
38	13	L					4	100		
39	13	H					5	100		
40	14	V		0	100	4	3	25	4	
41	14	L		1	25	3	4	25	4	
42	14	H		1	40	3	5	25	4	

COLUMN NO.	CONFIGURATION	CONDITION
1	CLEAN CONFIGURATION	IGE HOVER
2		OGE HOVER
3		V_H
4		$0.9 V_H$
5		$0.8 V_H$
6		$0.7 V_H$
7		V_{LOITER}
8		V_{BEST} R/C
9		V_{CRUISE} R/C
10		V_{MIN} R/D
11		V_{CRUISE} R/D
12		T/O A
13		LDG A
14		LDG B
15		15° RT
16		30° RT
17		15° LT
18		30° LT
19	POD CONFIGURATION	IGE HOVER
20		OGE HOVER
21		V_H
22		$0.9 V_H$
23		$0.8 V_H$
24		$0.7 V_H$
25		V_{LOITER}
26		V_{BEST} R/C
27		V_{CRUISE} R/C
28		V_{MIN} R/D
29		V_{CRUISE} R/D
30		T/O A
31		LDG A
32		LDG B
33		15° RT
34		30° RT
35		15° LT
36		30° LT
37	SLING LOAD CONFIGURATION	OGE HOVER
38		V_H
39		$0.9 V_H$
40		$0.8 V_H$
41		$0.7 V_H$
42		V_{LOITER}
43		V_{BEST} R/C
44		V_{CRUISE} R/C
45		V_{MIN} R/D
46		V_{CRUISE} R/D
47		T/O A
48		LDG A
49		10° RT
50		20° RT
51		10° LT
52		20° LT
53		GRND IDLE
54		GRND FLT IDLE
55		APP ONLY

FIGURE 3
THIRD PASS DATA COMPRESSION ARRAY
CH-54B USA S/N 69-18463

Legend: DELETED (hatched); V ~ VERTICAL; L ~ LATERAL; H ~ LONGITUDINAL

ROW	LOCATION	AXIS	LOCATION NAME	FLT 9 ONLY SM. POS	FLT 9 ONLY AMP. VO	FLT 9 ONLY TRACK	FLT 1-8,10-17 SM POS	FLT 1-8,10-17 AMP. VO	FLT 1-8,10-17 TRACK	PHASE
1	1	V	INSTRUMENT PANEL				0	25	3	I
2	1	L		0	40	3	1	25		
3	1	H		0	55	3	2	25		
4	2	V					0	40		
5	2	L					1	40		
6	2	H					2	40		
7	3	V					0	55		
8	3	L					1	55		
9	3	H					2	55		
10	4	V					0	70		
11	4	L					1	70		
12	4	H					2	70		
13	5	V					0	85		
14	5	L					1	85		
15	5	H					2	85		
16	6	V					0	100		
17	6	L					1	100		
18	6	H					2	100		
19	7	V		0	55	4	0	25	4	
20	7	L		0	70	4	1	25	4	
21	7	H		0	85	4	2	25	4	
22	8	V	AVIONICS	0	70	3	3	25	3	
23	8	L		0	85	3	4	25		
24	8	H		0	100	3	5	25		
25	9	V					3	40		
26	9	L					4	40		
27	9	H					5	40		
28	10	V					3	55		
29	10	L					4	55		
30	10	H					5	55		
31	11	V					3	70		
32	11	L					4	70		
33	11	H					5	70		
34	12	V					3	85		
35	12	L					4	85		
36	12	H					5	85		
37	13	V					3	100		
38	13	L					4	100		
39	13	H					5	100		
40	14	V		0	100	4	3	25	4	
41	14	L		1	25	3	4	25	4	
42	14	H		1	40	3	5	25	4	

COLUMN NO.	Configuration	Condition
1	CLEAN CONFIGURATION	IGE HOVER
2	CLEAN CONFIGURATION	OGE HOVER
3	CLEAN CONFIGURATION	V_H
4	CLEAN CONFIGURATION	$0.9V_H$
5	CLEAN CONFIGURATION	$0.8V_H$
6	CLEAN CONFIGURATION	$0.7V_H$
7	CLEAN CONFIGURATION	V_{LOITER}
8	CLEAN CONFIGURATION	V_{BEST} R/C
9	CLEAN CONFIGURATION	V_{CRUISE} R/C
10	CLEAN CONFIGURATION	V_{MIN} R/D
11	CLEAN CONFIGURATION	V_{CRUISE} R/D
12	CLEAN CONFIGURATION	T/O A
13	CLEAN CONFIGURATION	LDG A
14	CLEAN CONFIGURATION	LDG B
15	CLEAN CONFIGURATION	15° RT
16	CLEAN CONFIGURATION	30° RT.
17	CLEAN CONFIGURATION	15° LT
18	CLEAN CONFIGURATION	30° LT
19	POD CONFIGURATION	IGE HOVER
20	POD CONFIGURATION	OGE HOVER
21	POD CONFIGURATION	V_H
22	POD CONFIGURATION	$0.9V_H$
23	POD CONFIGURATION	$0.8V_H$
24	POD CONFIGURATION	$0.7V_H$
25	POD CONFIGURATION	V_{LOITER}
26	POD CONFIGURATION	V_{BEST} R/C
27	POD CONFIGURATION	V_{CRUISE} R/C
28	POD CONFIGURATION	V_{MIN} R/D
29	POD CONFIGURATION	V_{CRUISE} R/D
30	POD CONFIGURATION	T/O A
31	POD CONFIGURATION	LDG A
32	POD CONFIGURATION	LDG B
33	POD CONFIGURATION	15° RT
34	POD CONFIGURATION	30° RT
35	POD CONFIGURATION	15° LT
36	POD CONFIGURATION	30° LT
37	SLING LOAD CONFIGURATION	OGE HOVER
38	SLING LOAD CONFIGURATION	V_H
39	SLING LOAD CONFIGURATION	$0.9V_H$
40	SLING LOAD CONFIGURATION	$0.8V_H$
41	SLING LOAD CONFIGURATION	$0.7V_H$
42	SLING LOAD CONFIGURATION	V_{LOITER}
43	SLING LOAD CONFIGURATION	V_{BEST} R/C
44	SLING LOAD CONFIGURATION	V_{CRUISE} R/C
45	SLING LOAD CONFIGURATION	V_{MIN} R/D
46	SLING LOAD CONFIGURATION	V_{CRUISE} R/D
47	SLING LOAD CONFIGURATION	T/O A
48	SLING LOAD CONFIGURATION	LDG A
49	SLING LOAD CONFIGURATION	10° RT
50	SLING LOAD CONFIGURATION	20° RT
51	SLING LOAD CONFIGURATION	10° LT
52	SLING LOAD CONFIGURATION	20° LT
53		GRND. IDLE
54		GRND FLT IDLE
55		APP. ONLY

FIG 4

COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

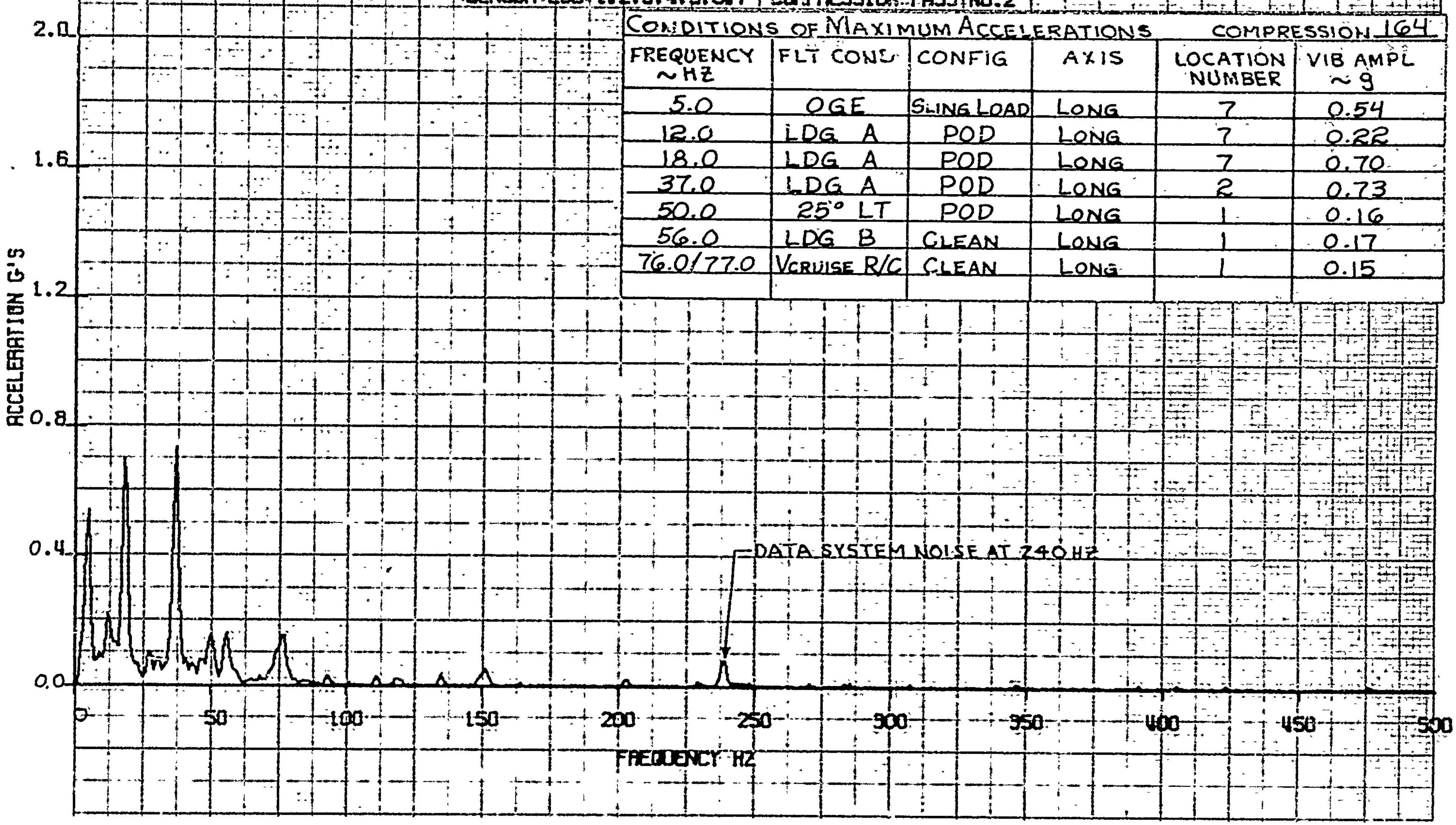
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS INSTR PANEL COMBINED AXIS VIB PLOT 164

SENSOR LOC 1,2,3,4,5,6,7 COMPRESSION PASS NO.2

CONDITIONS OF MAXIMUM ACCELERATIONS — COMPRESSION 164

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
5.0	OGE	SLING LOAD	LONG	7	0.54
12.0	LDG A	POD	LONG	7	0.22
18.0	LDG A	POD	LONG	7	0.70
37.0	LDG A	POD	LONG	2	0.73
50.0	25° LT	POD	LONG	1	0.16
56.0	LDG B	CLEAN	LONG	1	0.17
76.0/77.0	VCRUISE R/C	CLEAN	LONG	1	0.15



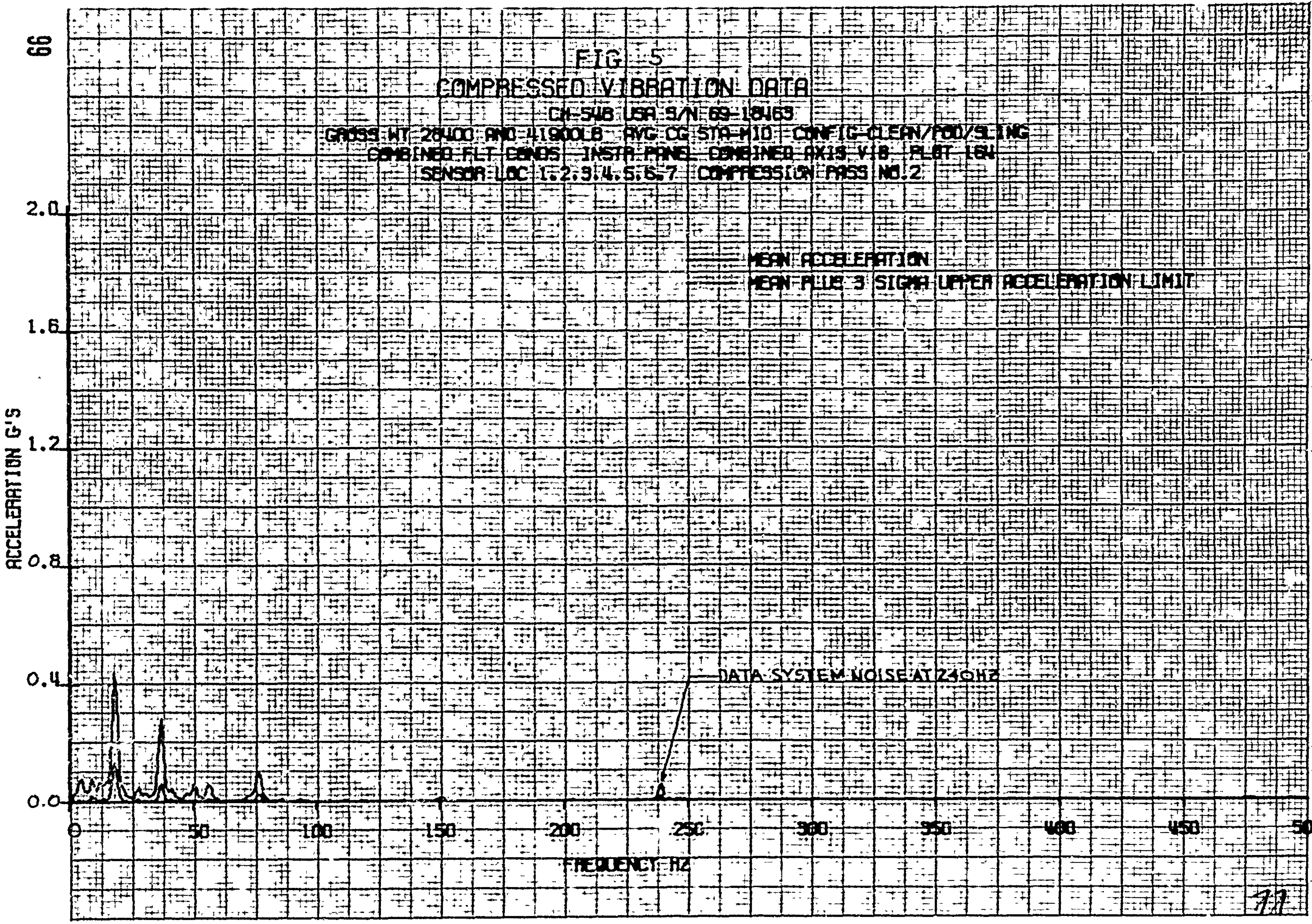


FIG 5
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS INSTR PANEL COMBINED AXIS VIB PLOT 164
SENSOR LOC 1,2,3,4,5,6,7 COMPRESSION PASS NO.2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240HZ
ACCELERATION G'S
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ
77

FIG 6

COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

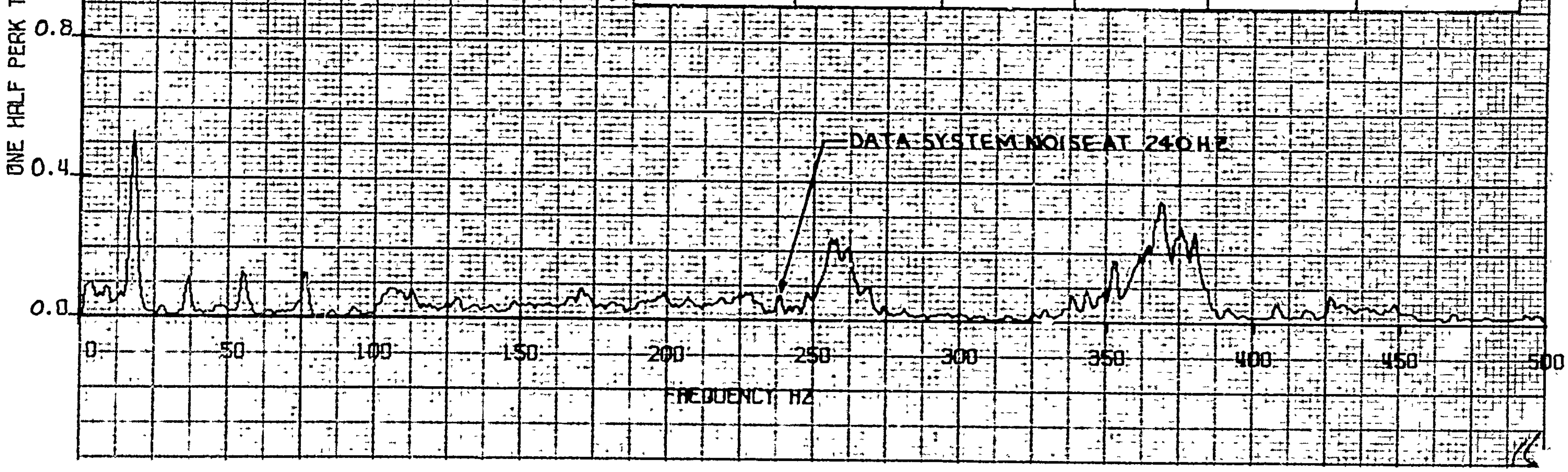
GROSS WT 28400 AND 41900LB AVG CG STA MID CONFIG CLEAN/POD/SLING

COMBINED FLT CONDS AVIONICS COMBINED AXIS VIB FLGT 195

SENSOR LOC 8.9.10.11.12.13 COMPRESSION PASS NO 2

CONDITIONS OF MAXIMUM ACCELERATIONS — COMPRESSION 195

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
18.0	LDG B	CLEAN	LONG	13	0.53
37.0	LDG A	POD	LAT	13	0.11
55.0	LDG B	CLEAN	VERT	12	0.13
76.0	10° RT	SLING LOAD	VERT	13	0.13
256.0	LDG A	POD	LONG	12	0.24
262.0	T/O	SLING LOAD	LONG	12	0.21
352.0	25° LT	POD	LAT	12	0.18
368.0	LF (VH)	CLEAN	LAT	13	0.35
375.0	LF (VH)	CLEAN	LAT	13	0.28
380.0	15° LT	CLEAN	LAT	13	0.26



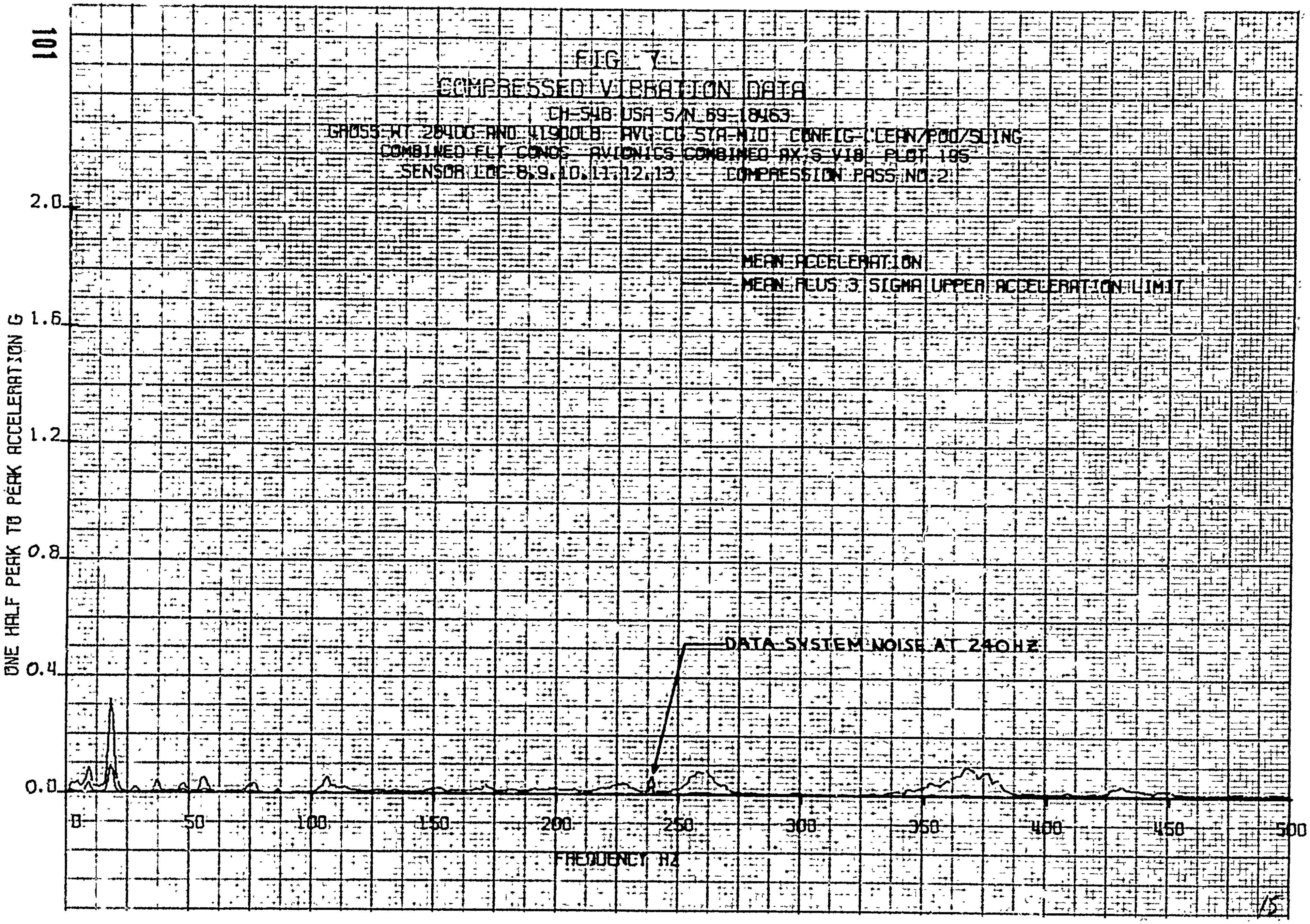


FIG. 7
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 20400 AND 41900LB AVG CG STA MID CONFIG CLEAN/POD/SLING
COMBINED FLT CONDS AVIONICS COMBINED AX S V18 PLOT 195
SENSOR LOC 8,9,10,11,12,13 COMPRESSION PASS NO.2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240HZ
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

15

FIG 8

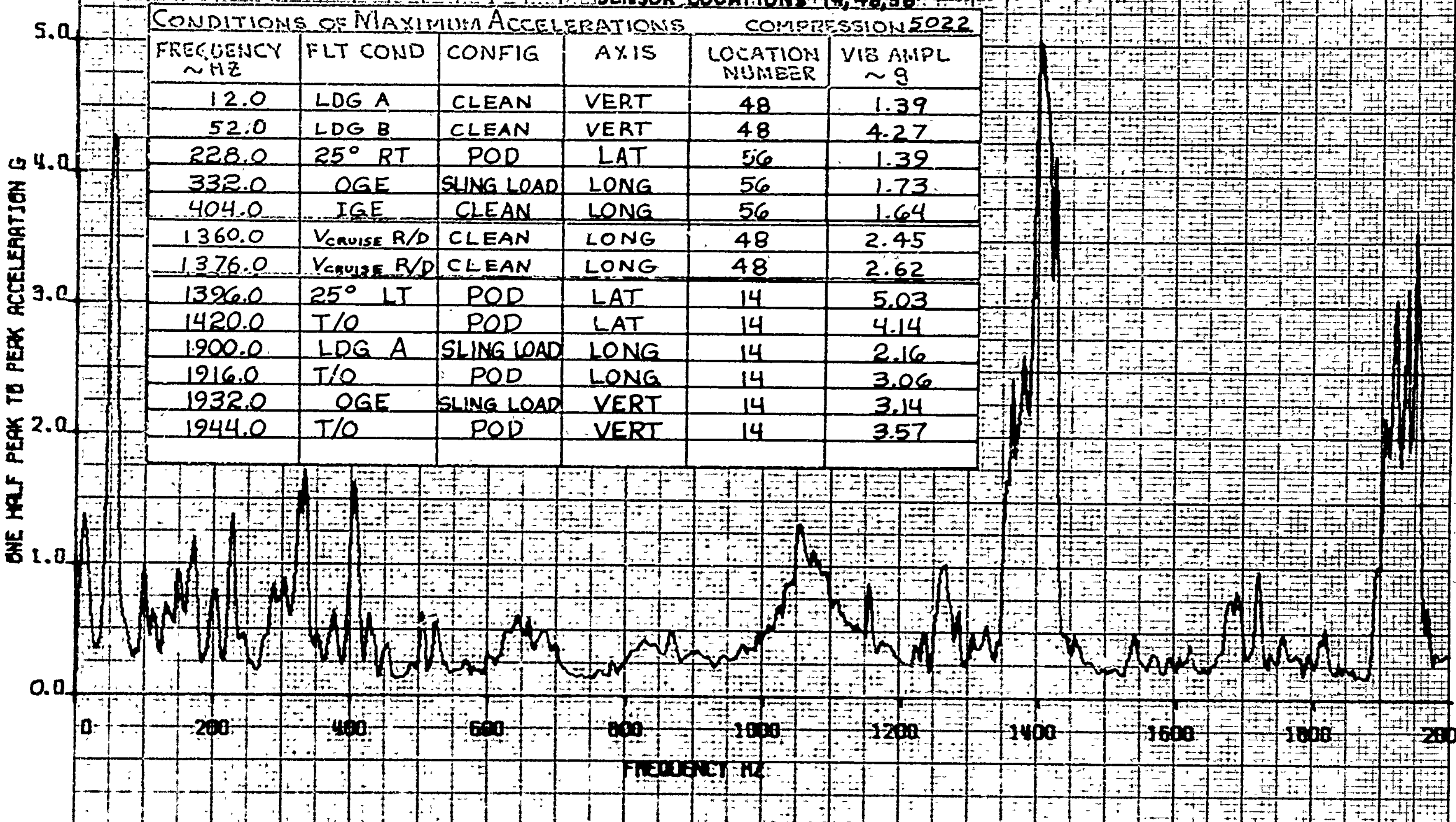
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

GROSS WT 28400 LB AVG CG STA MID CONFIG-CLEAN

COMBINED FLT CONDS AVIONICS AFT FUSELAGE COMBINED AXIS VIB PLOT 5022

SENSOR LOCATIONS 14,48,56



CONDITIONS OF MAXIMUM ACCELERATIONS — COMPRESSION 5022

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
12.0	LDG A	CLEAN	VERT	48	1.39
52.0	LDG B	CLEAN	VERT	48	4.27
228.0	25° RT	POD	LAT	56	1.39
332.0	OGE	SLING LOAD	LONG	56	1.73
404.0	IGE	CLEAN	LONG	56	1.64
1360.0	V_{CRUISE} R/D	CLEAN	LONG	48	2.45
1376.0	V_{CRUISE} R/D	CLEAN	LONG	48	2.62
1396.0	25° LT	POD	LAT	14	5.03
1420.0	T/O	POD	LAT	14	4.14
1900.0	LDG A	SLING LOAD	LONG	14	2.16
1916.0	T/O	POD	LONG	14	3.06
1932.0	OGE	SLING LOAD	VERT	14	3.14
1944.0	T/O	POD	VERT	14	3.57

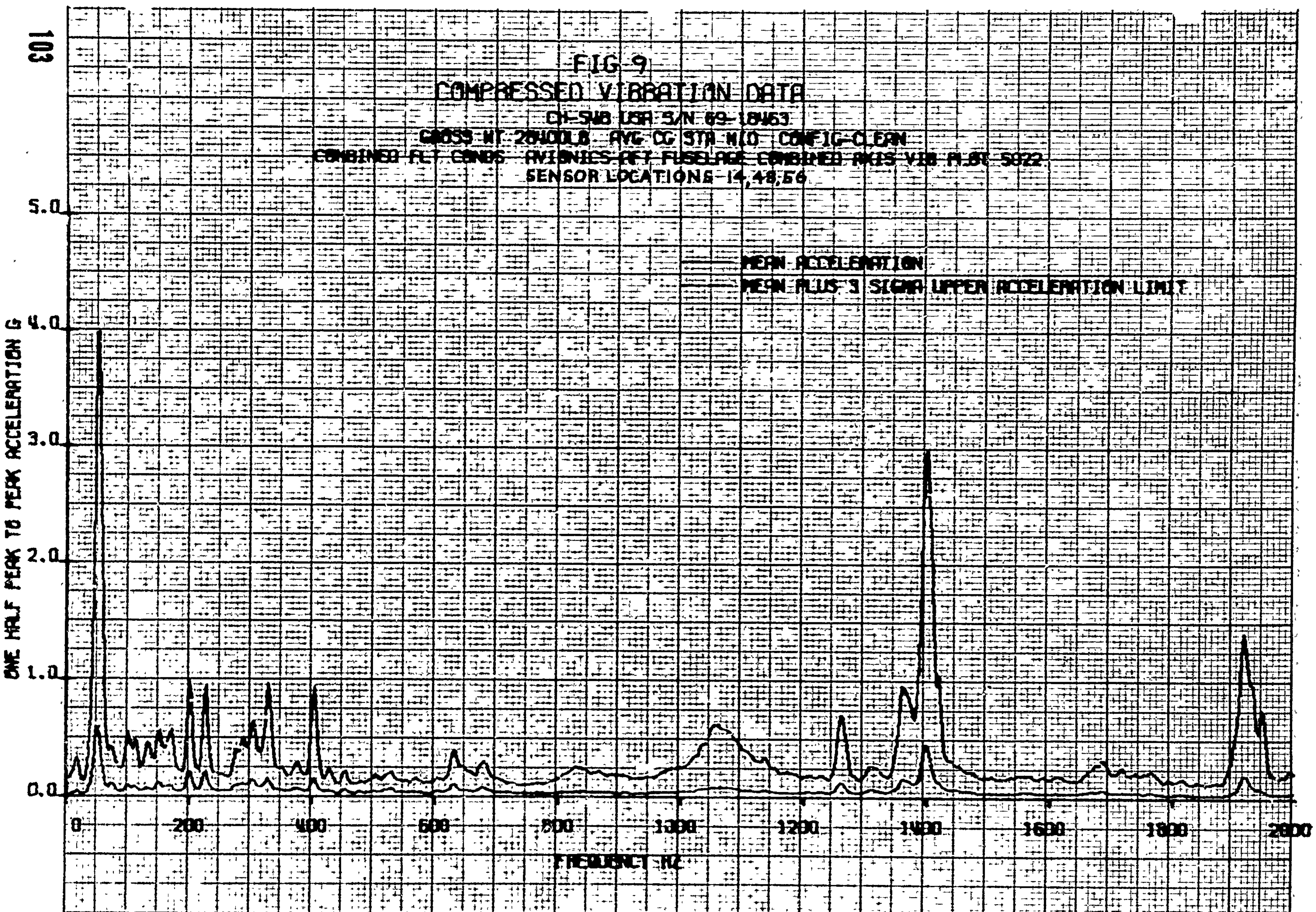


FIG 9
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400LB AVG CG STA MID CONFIG-CLEAN
COMBINED FLT CONDS AVIONICS-AFT FUSELAGE COMBINED AXIS VIB PLOT 5022
SENSOR LOCATIONS-14,48,56

FIG 10

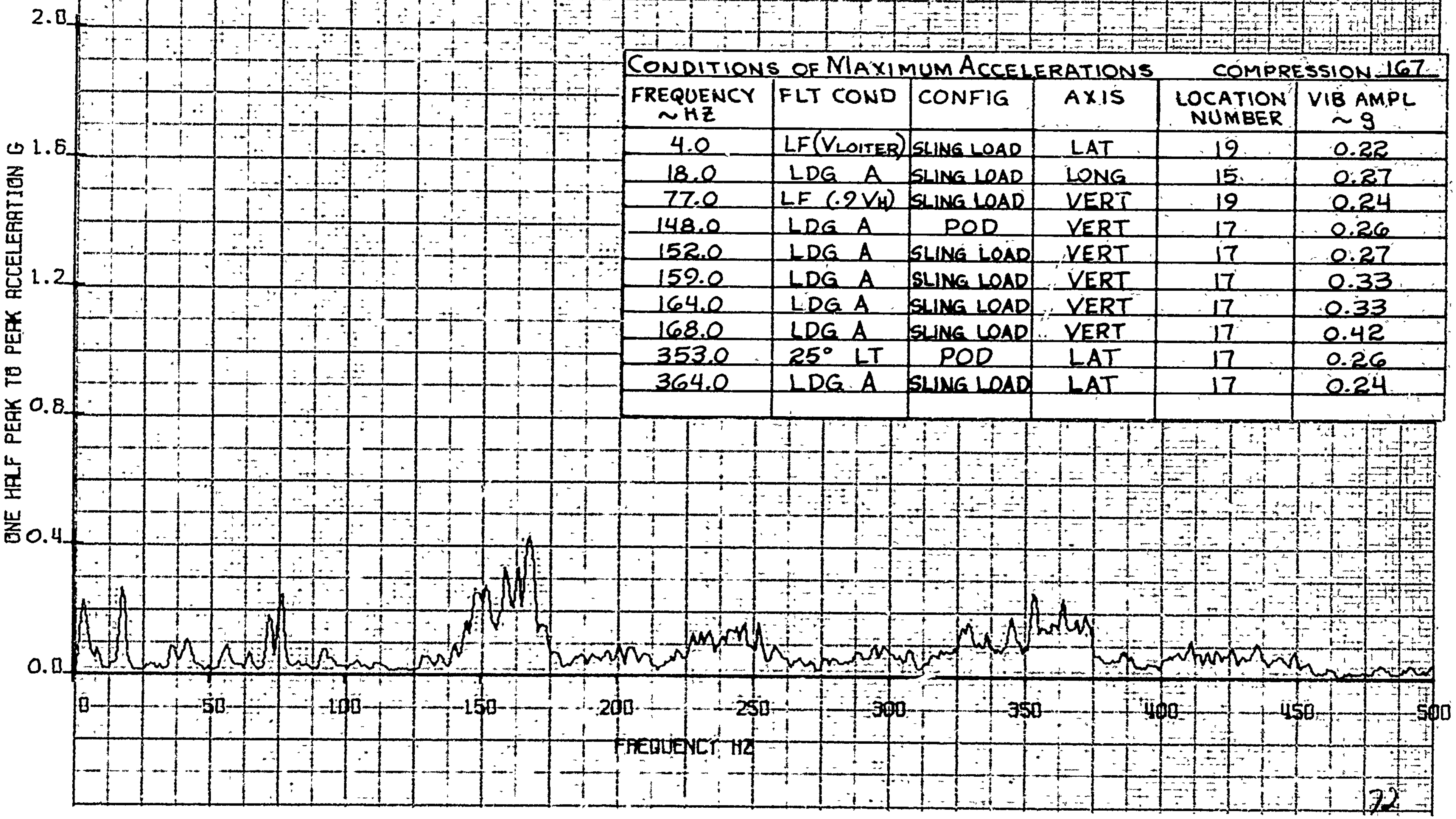
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS HUMAN FACTORS INPUT COMBINED AXIS VIB PLOT 167

SENSOR LOC 15,16,17,18,19 COMPRESSION PASS NO.2



CONDITIONS OF MAXIMUM ACCELERATIONS COMPRESSION 167

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
4.0	LF(V_{LOITER})	SLING LOAD	LAT	19	0.22
18.0	LDG A	SLING LOAD	LONG	15	0.27
77.0	LF (.9V_H)	SLING LOAD	VERT	19	0.24
148.0	LDG A	POD	VERT	17	0.26
152.0	LDG A	SLING LOAD	VERT	17	0.27
159.0	LDG A	SLING LOAD	VERT	17	0.33
164.0	LDG A	SLING LOAD	VERT	17	0.33
168.0	LDG A	SLING LOAD	VERT	17	0.42
353.0	25° LT	POD	LAT	17	0.26
364.0	LDG A	SLING LOAD	LAT	17	0.24

72

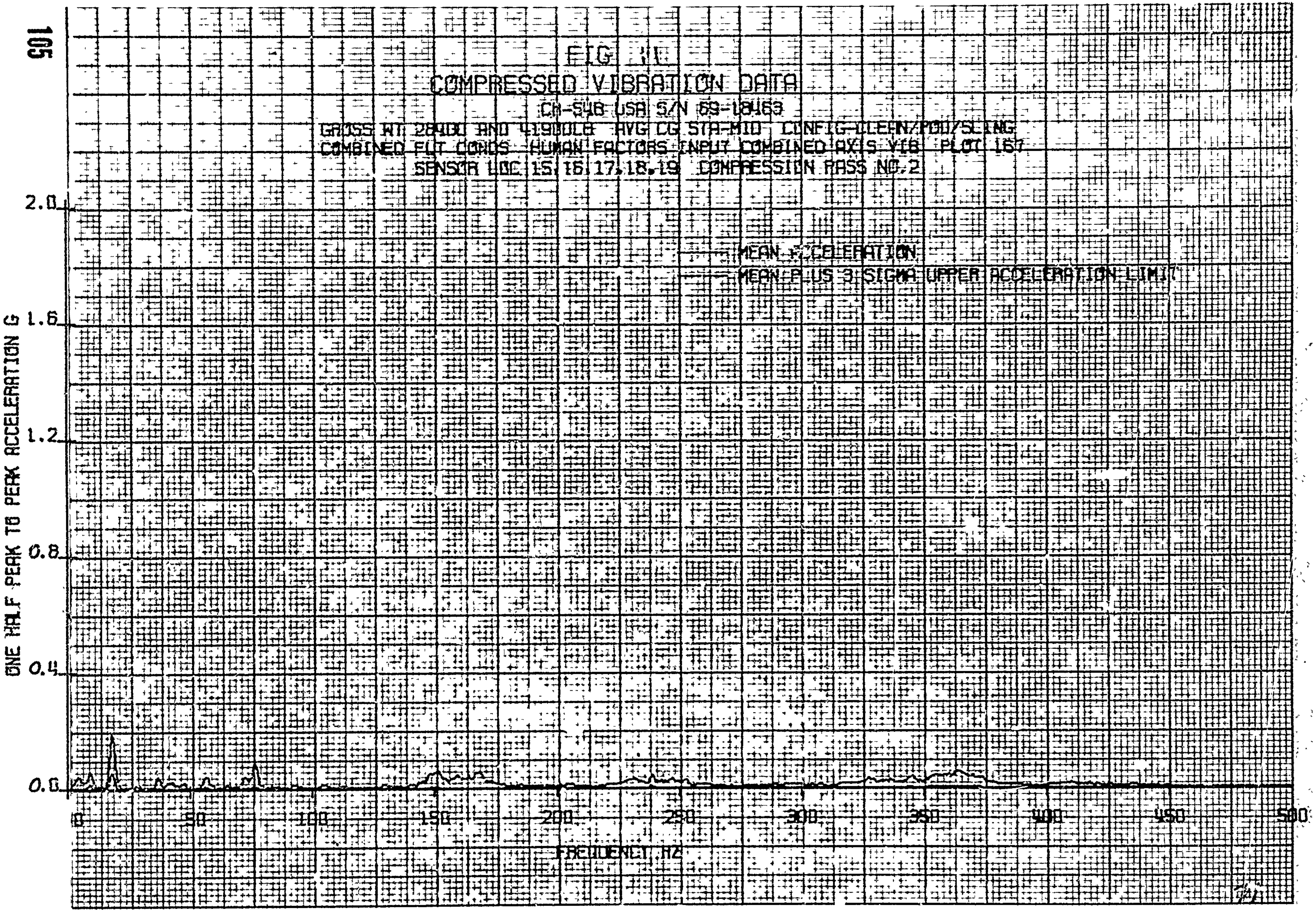


FIG
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS HUMAN FACTORS INPUT COMBINED AXIS VIB PLOT 167
SENSOR LOC 15,16,17,18,19 COMPRESSION PASS NO.2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

FIG 12

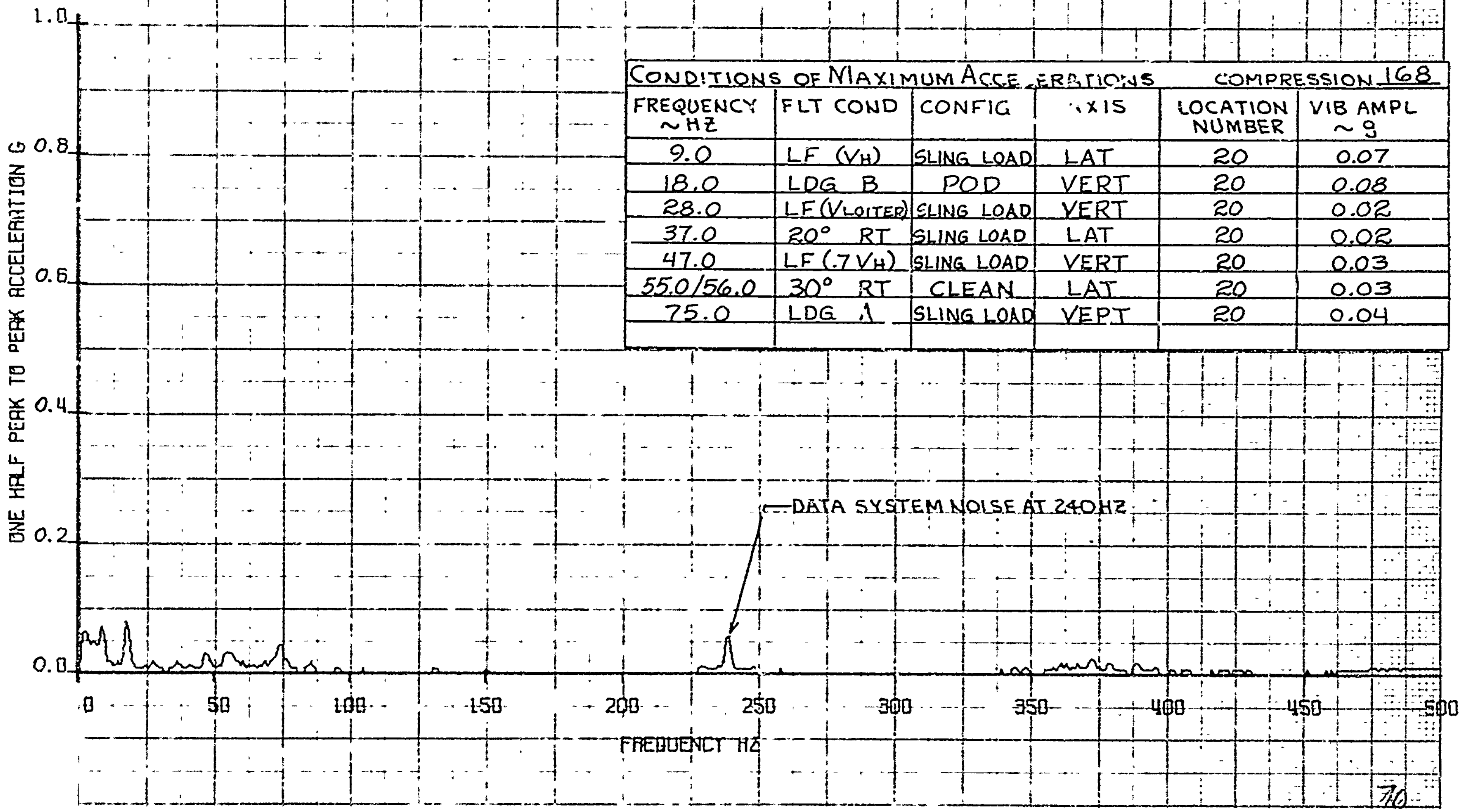
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS HUMAN FACTORS OUTPUT COMBINED AXIS VIB PLOT 168

SENSOR LOC 20.21 COMPRESSION PASS NO 2



CONDITIONS OF MAXIMUM ACCELERATIONS — COMPRESSION 168

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
9.0	LF (V_H)	SLING LOAD	LAT	20	0.07
18.0	LDG B	POD	VERT	20	0.08
28.0	LF (V_{LOITER})	SLING LOAD	VERT	20	0.02
37.0	20° RT	SLING LOAD	LAT	20	0.02
47.0	LF (.7 V_H)	SLING LOAD	VERT	20	0.03
55.0/56.0	30° RT	CLEAN	LAT	20	0.03
75.0	LDG A	SLING LOAD	VERT	20	0.04

FIG 13

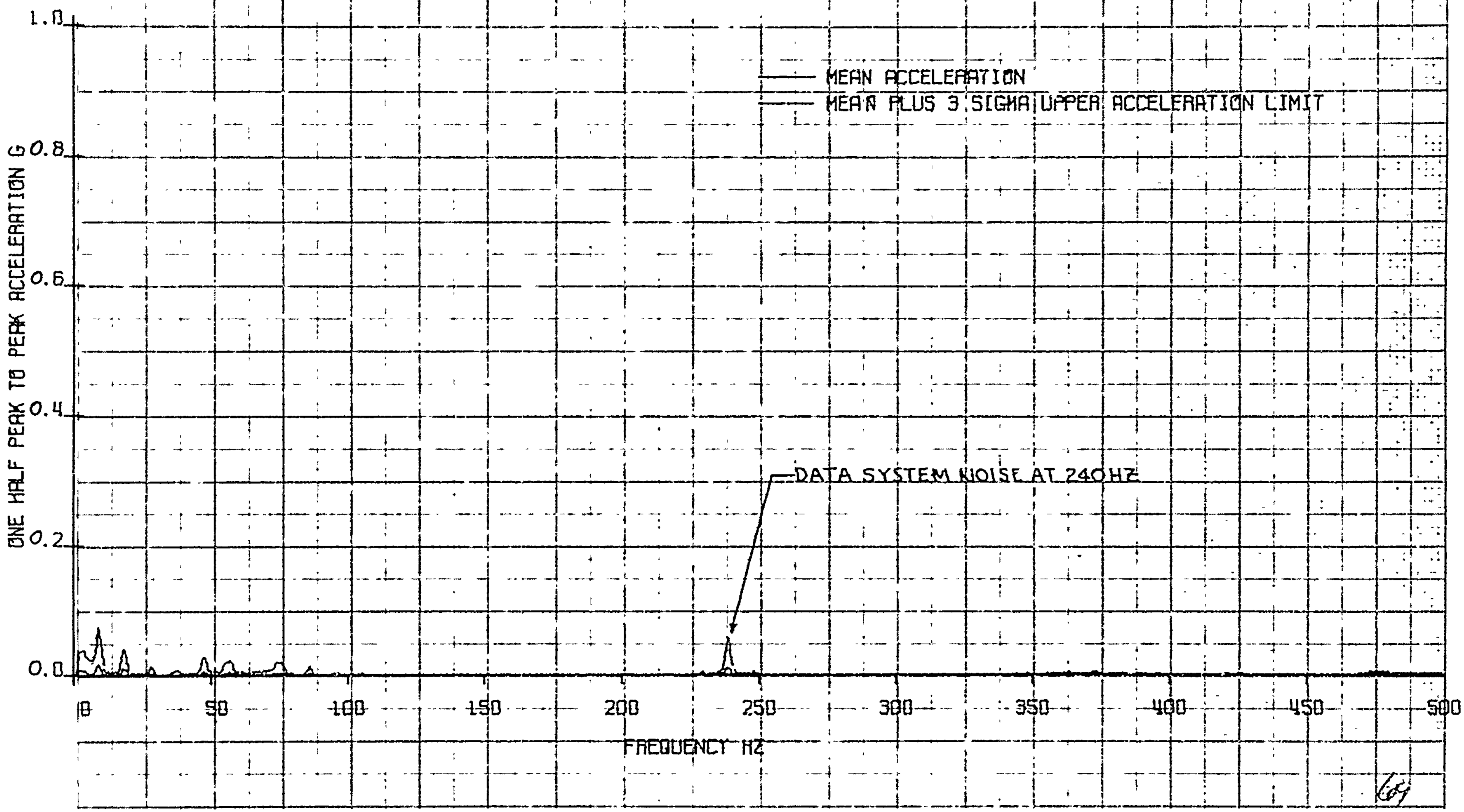
COMPRESSED VIBRATION DATA

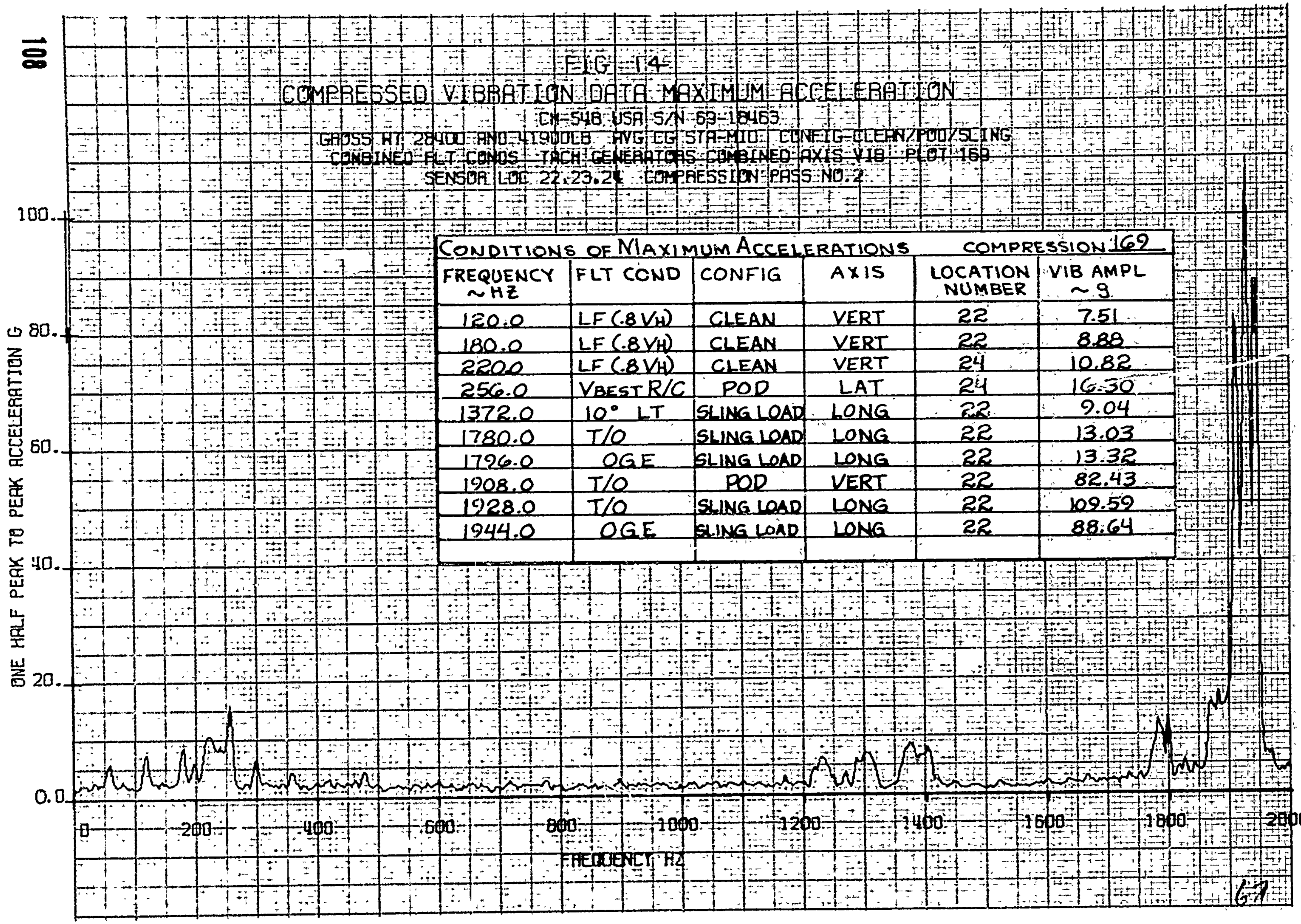
CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

~~COMBINED FLT CONDS HUMAN FACTORS OUTPUT COMBINED AXIS VIB PLOT 168~~

SENSOR LOC 20,21 COMPRESSION PASS NO 2





CONDITIONS OF MAXIMUM ACCELERATIONS — COMPRESSION 169

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
120.0	LF (.8 VH)	CLEAN	VERT	22	7.51
180.0	LF (.8 VH)	CLEAN	VERT	22	8.88
2200	LF (.8 VH)	CLEAN	VERT	24	10.82
256.0	VBEST R/C	POD	LAT	24	16.30
1372.0	10° LT	SLING LOAD	LONG	22	9.04
1780.0	T/O	SLING LOAD	LONG	22	13.03
1796.0	OGE	SLING LOAD	LONG	22	13.32
1908.0	T/O	POD	VERT	22	82.43
1928.0	T/O	SLING LOAD	LONG	22	109.59
1944.0	OGE	SLING LOAD	LONG	22	88.64

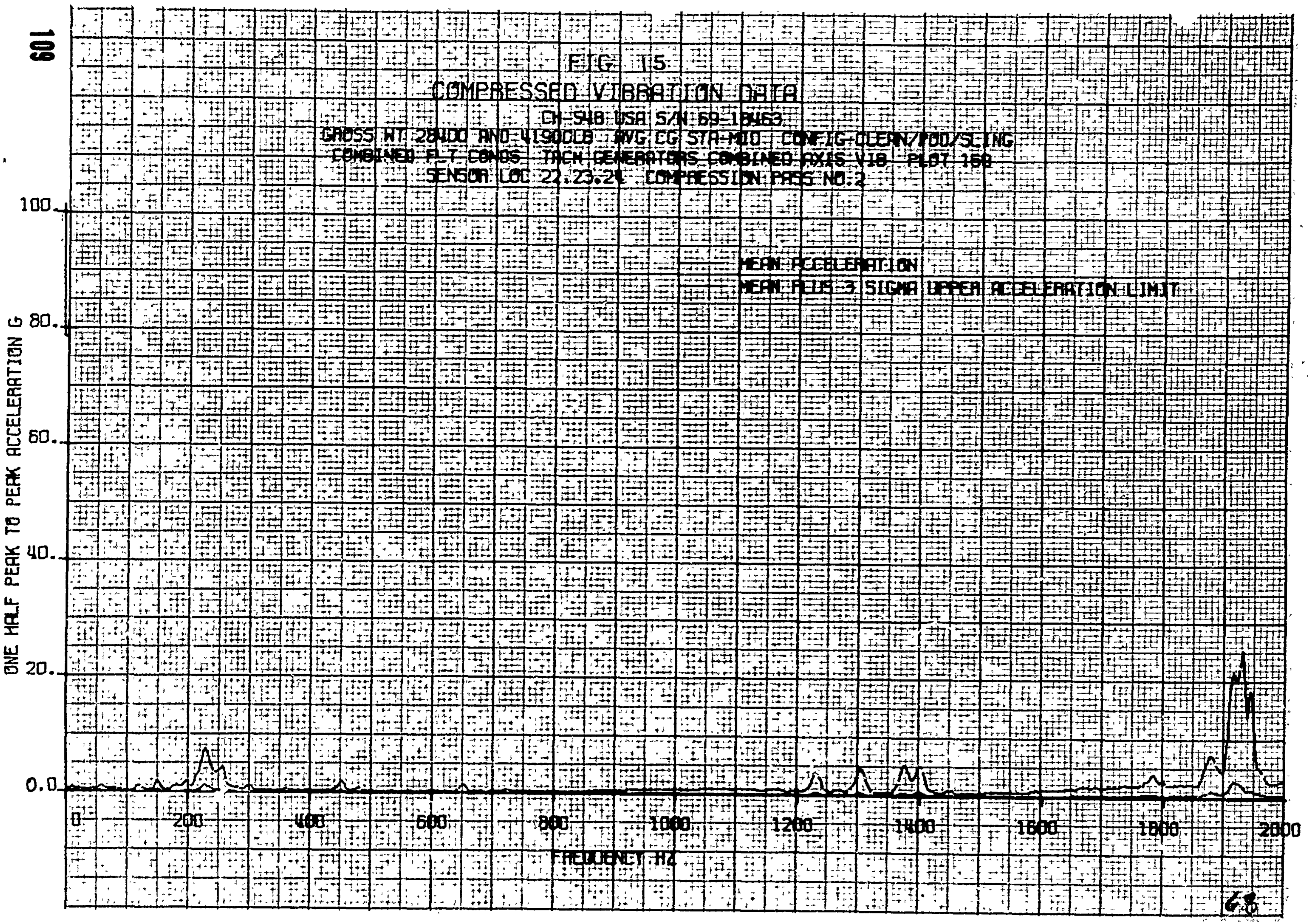


FIG. 15
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS TACH GENERATORS COMBINED AXIS V18 PLOT 160
SENSOR LOC 22.23.24 COMPRESSION PASS NO.2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
100.
80.
60.
40.
20.
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ
68

FIG 16

COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USB S/N 69-18463

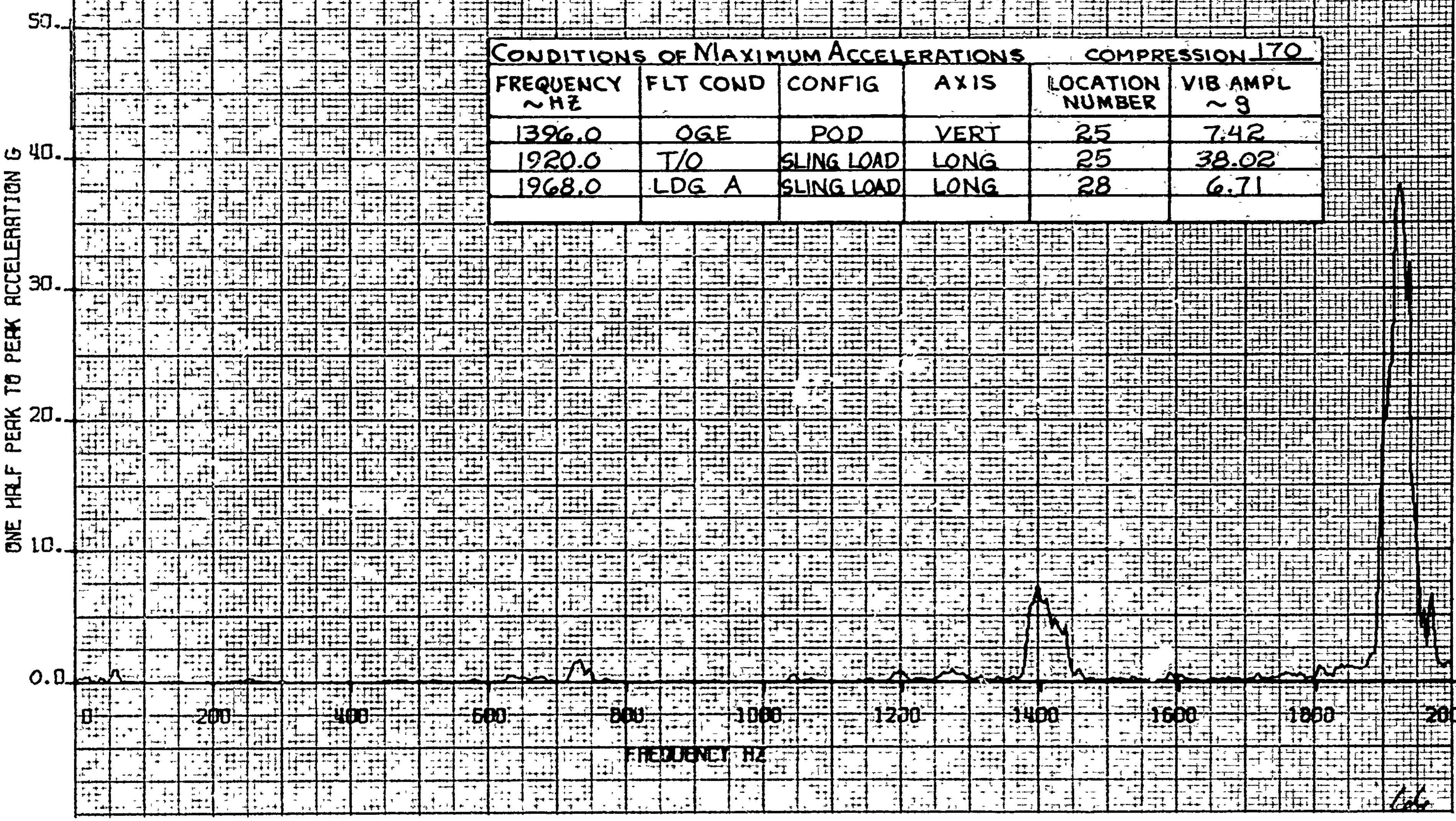
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS TRANS MOUNTS COMBINED AXIS V.8 PLOT 170

SENSOR LOC 25.26.27.28 COMPRESSION PASS NO.2

CONDITIONS OF MAXIMUM ACCELERATIONS COMPRESSION 170

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
1396.0	OGE	POD	VERT	25	7.42
1920.0	T/O	SLING LOAD	LONG	25	38.02
1968.0	LDG A	SLING LOAD	LONG	28	6.71



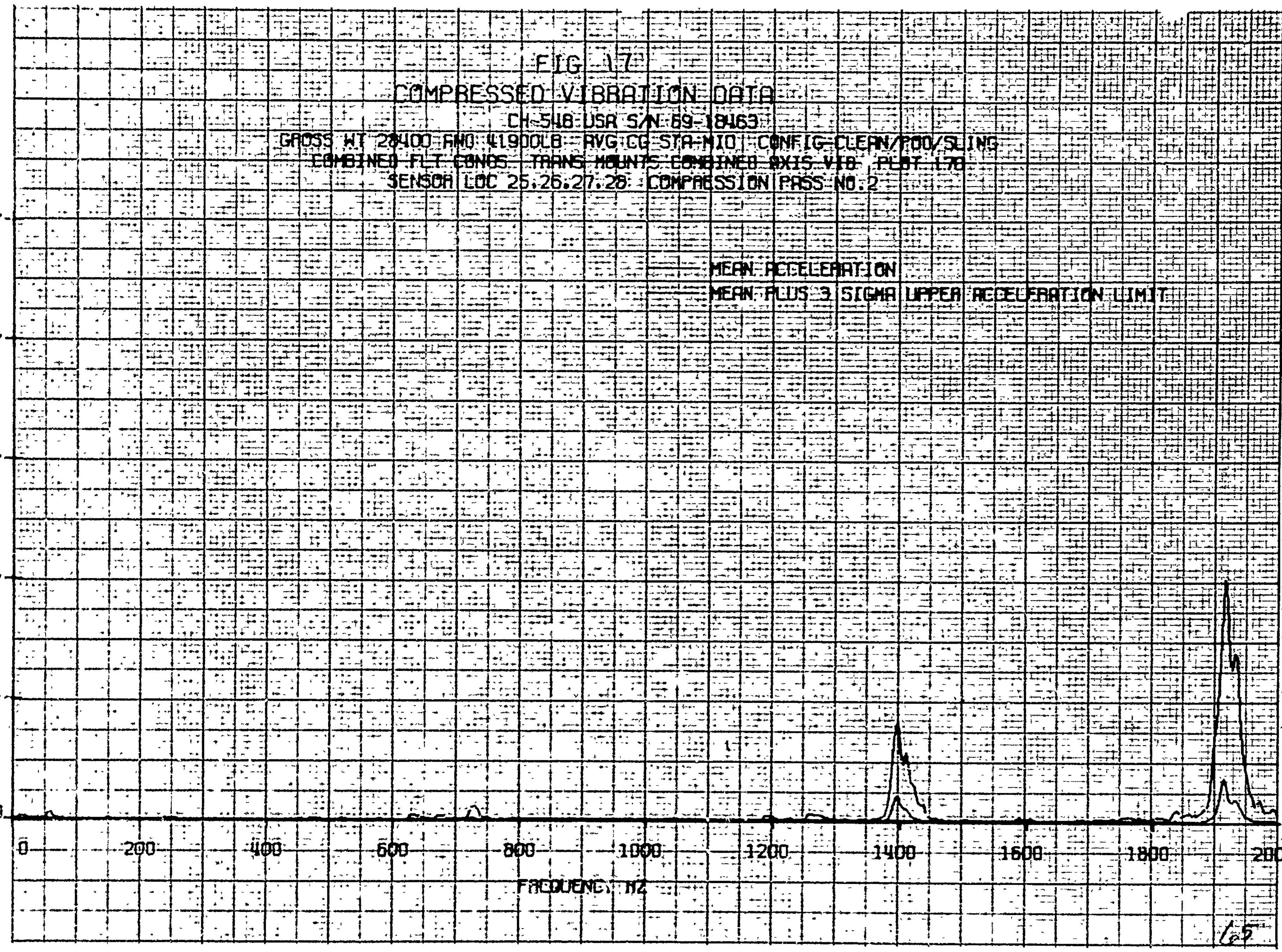


FIG 17
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS TRANS MOUNTS COMBINED AXIS VIB PLOT 178
SENSOR LOC 25.26.27.28 COMPRESSION PASS NO.2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
50.
40.
30.
20.
10.
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY, HZ
65

FIG 18

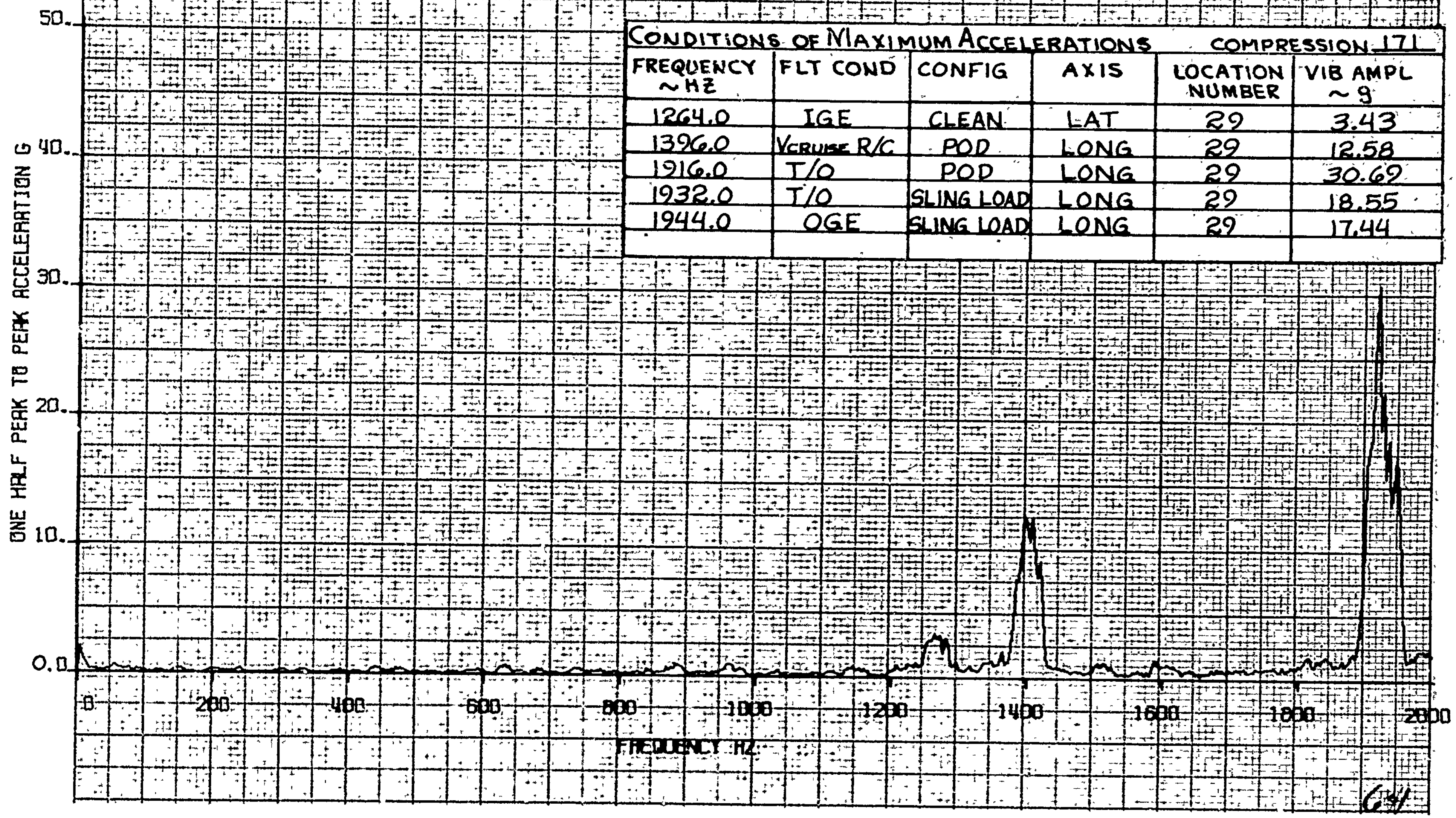
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

GROSS WT 20400 AND 41900LB AVG CG STA-MID CONFIG CLEAN/POD/SLING

COMBINED FLT CONDS UPPER MN TRANS COMBINED AXIS VIB PLOT 171

SENSOR LOC 29 COMPRESSION PASS NO.2



CONDITIONS OF MAXIMUM ACCELERATIONS COMPRESSION 171

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
1264.0	IGE	CLEAN	LAT	29	3.43
1396.0	V_{CRUISE} R/C	POD	LONG	29	12.58
1916.0	T/O	POD	LONG	29	30.69
1932.0	T/O	SLING LOAD	LONG	29	18.55
1944.0	OGE	SLING LOAD	LONG	29	17.44

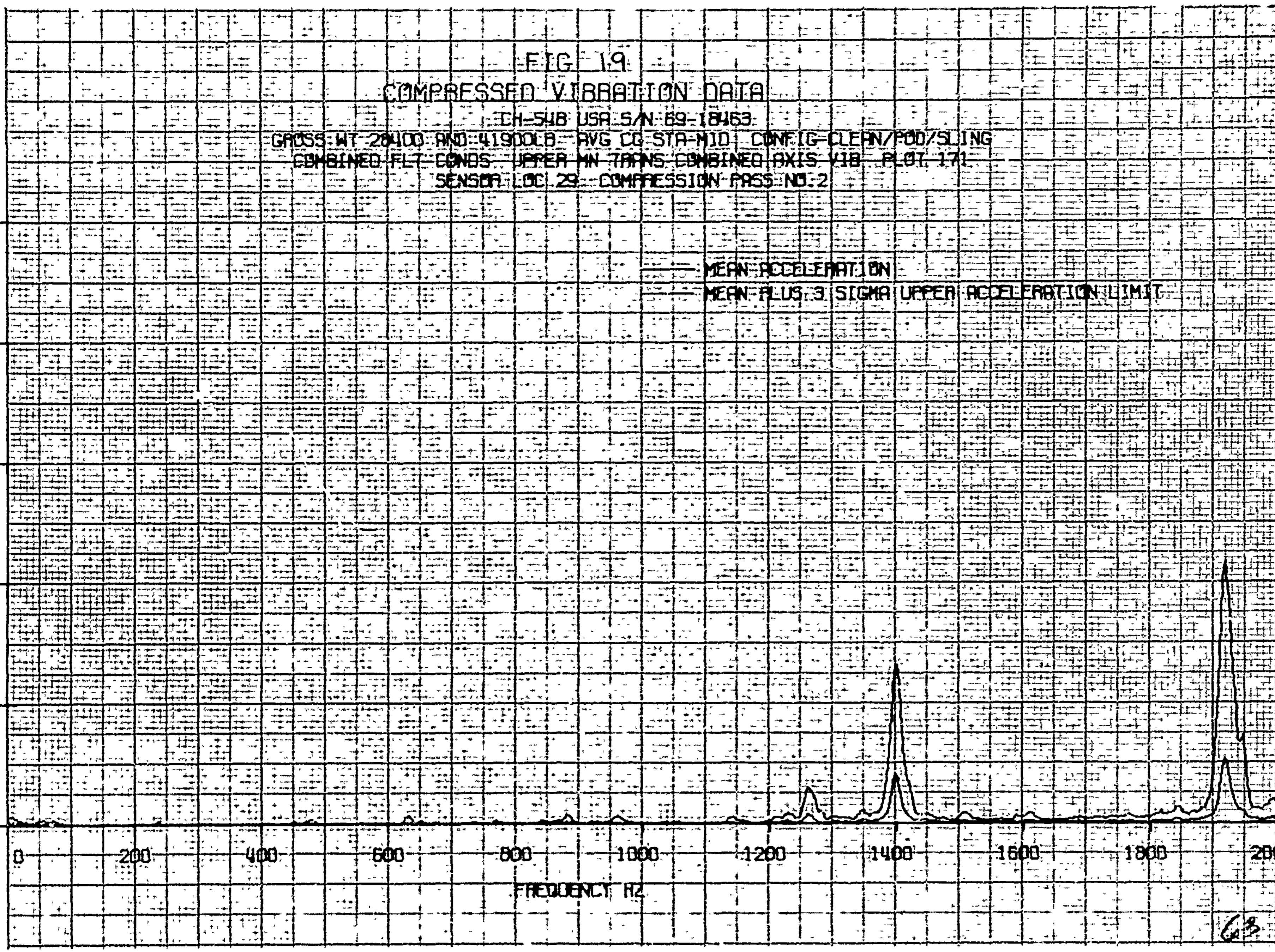


FIG 19
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 20400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS UPPER MN TRANS COMBINED AXIS VIB PLOT 171
SENSOR LOC 29 COMPRESSION PASS NO.2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
0.0
10.
20.
30.
40.
50.
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

114

FIG 20

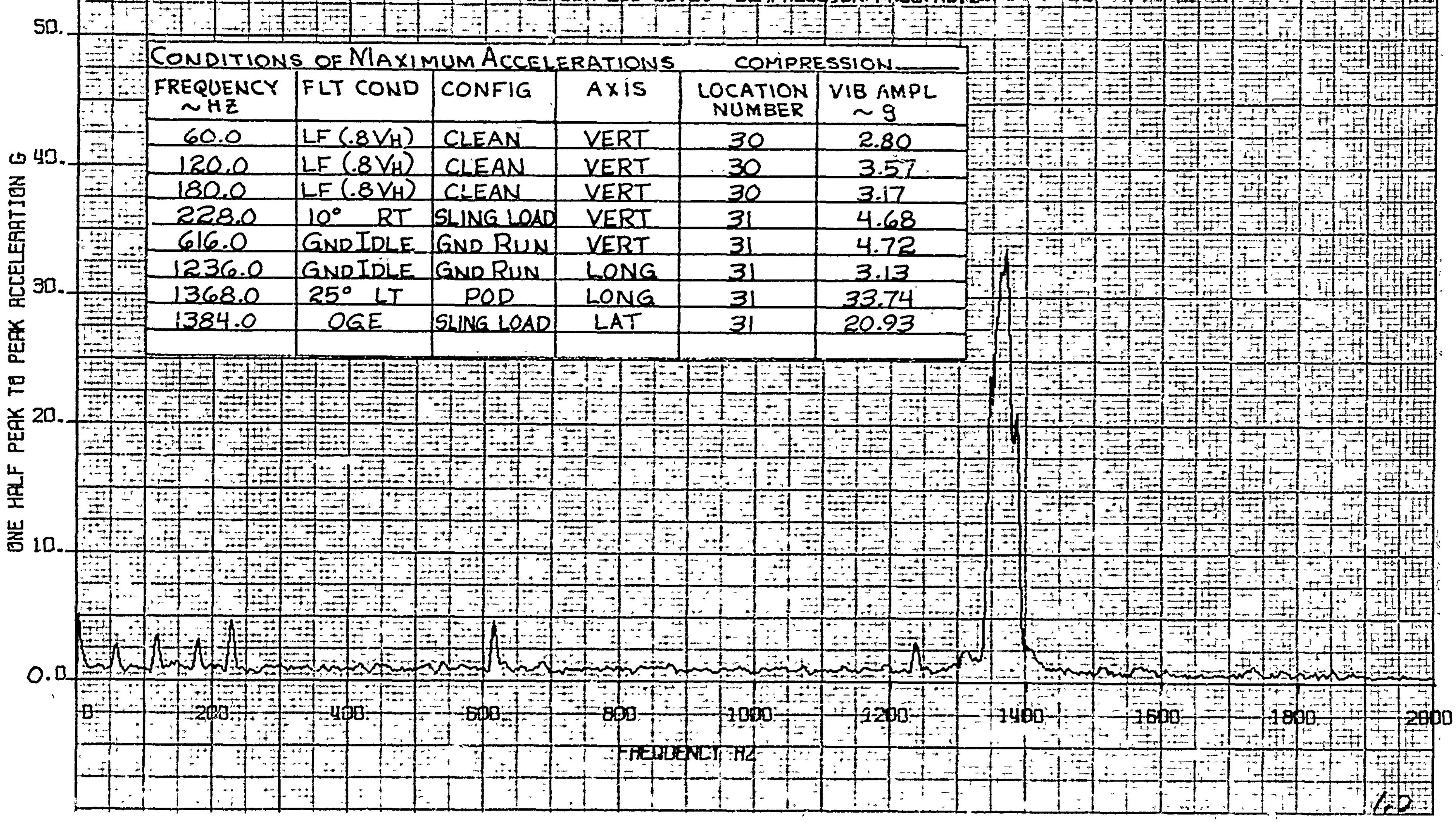
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS 45 AND 90DEG GB COMBINED AXIS VIB PLOT 172

SENSOR LOC 30,31 COMPRESSION PASS NO.2



CONDITIONS OF MAXIMUM ACCELERATIONS COMPRESSION

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
60.0	LF (.8VH)	CLEAN	VERT	30	2.80
120.0	LF (.8VH)	CLEAN	VERT	30	3.57
180.0	LF (.8VH)	CLEAN	VERT	30	3.17
228.0	10° RT	SLING LOAD	VERT	31	4.68
616.0	GND IDLE	GND RUN	VERT	31	4.72
1236.0	GND IDLE	GND RUN	LONG	31	3.13
1368.0	25° LT	POD	LONG	31	33.74
1384.0	OGE	SLING LOAD	LAT	31	20.93

I.D

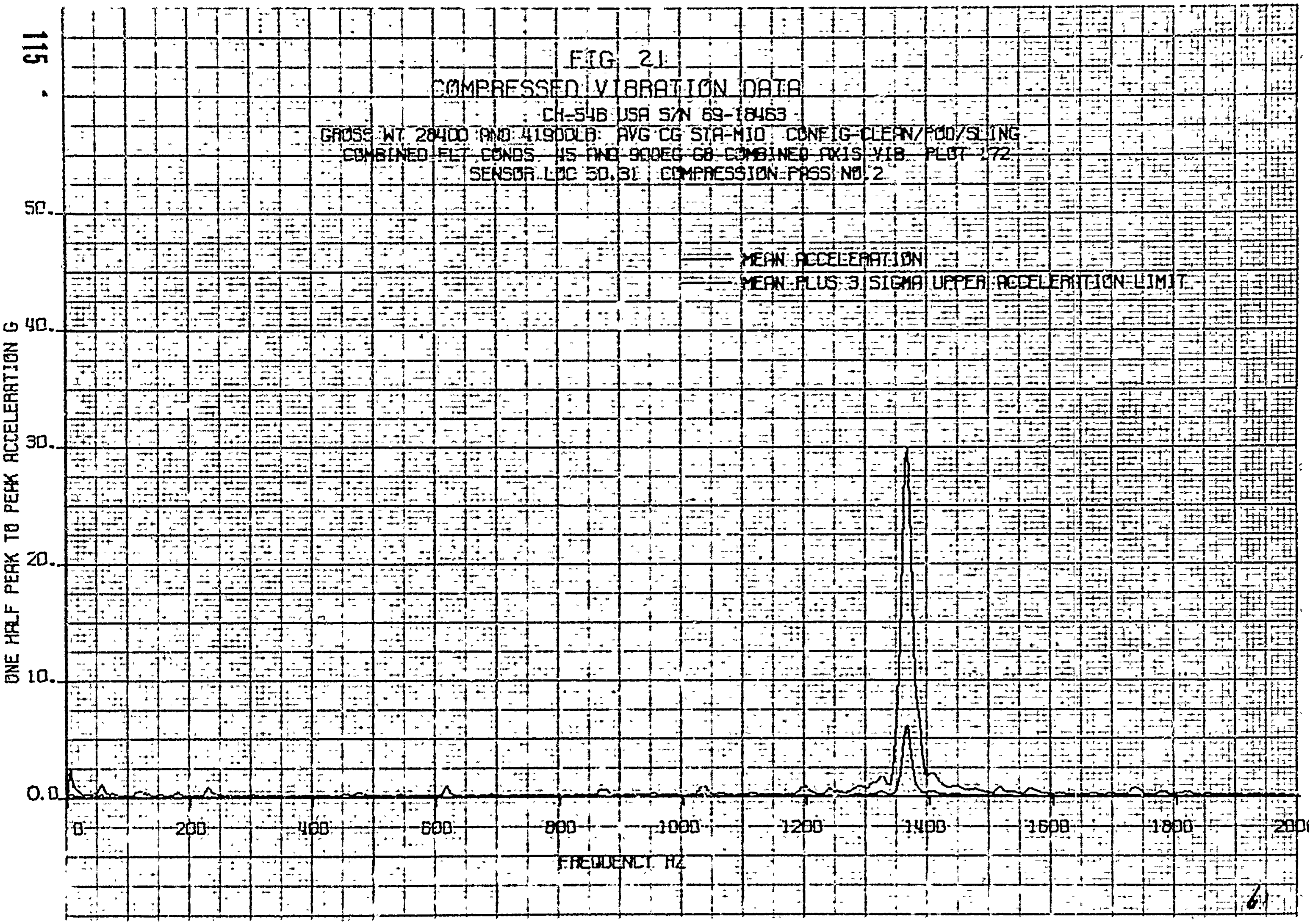


FIG 21
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS 45 AND 90DEG CB COMBINED AXIS VIB PLOT 172
SENSOR LOC 50.31 COMPRESSION PASS NO.2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
50.
40.
30.
20.
10.
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

FIG. 22

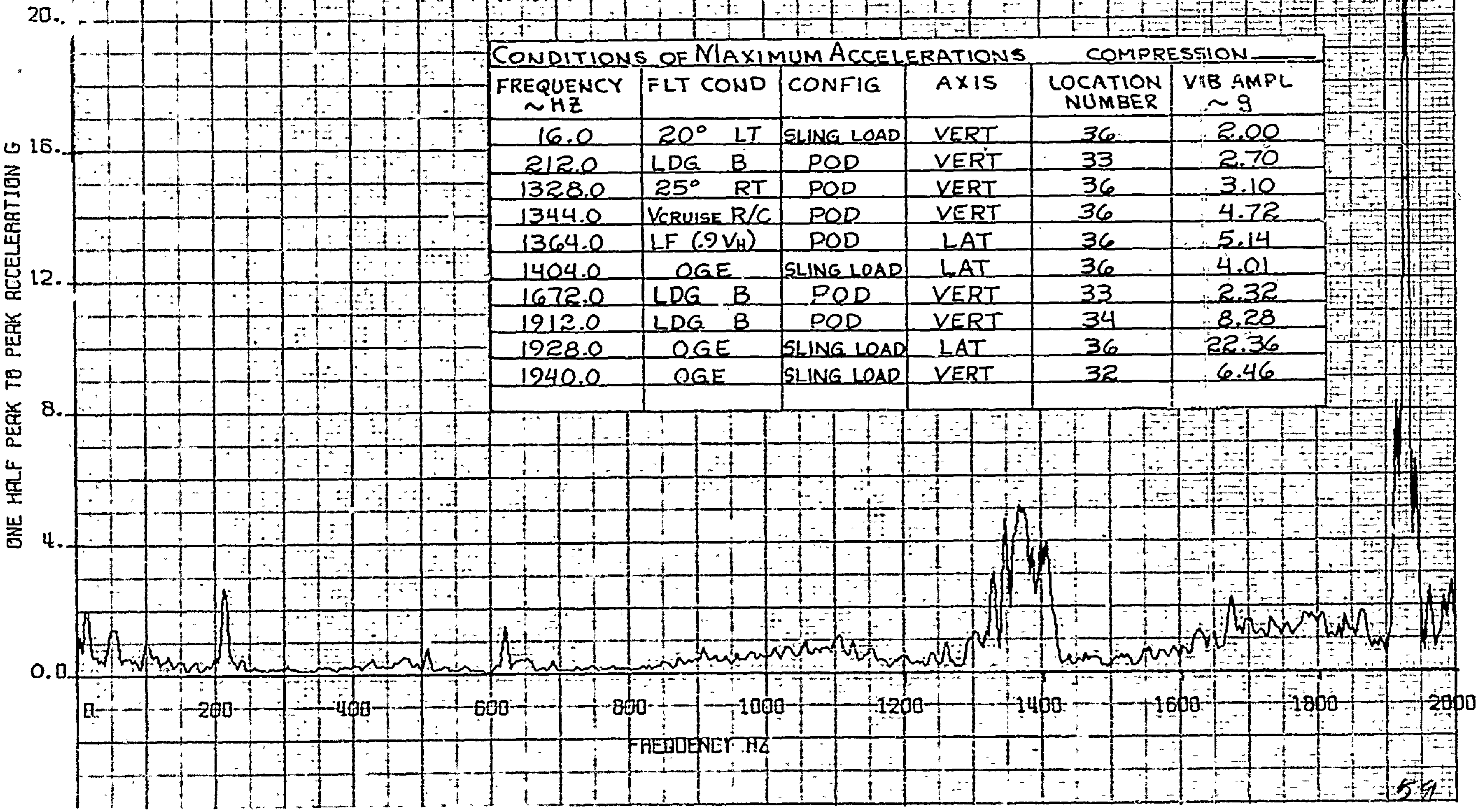
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS TAIL ROT SHAFT HGR BRGS COMBINED AXIS VIB PLOT 173

SENSOR LOC 32 33 34 35 36 COMPRESSION PASS NO. 2



CONDITIONS OF MAXIMUM ACCELERATIONS COMPRESSION

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
16.0	20° LT	SLING LOAD	VERT	36	2.00
212.0	LDG B	POD	VERT	33	2.70
1328.0	25° RT	POD	VERT	36	3.10
1344.0	V_{CRUISE} R/C	POD	VERT	36	4.72
1364.0	LF (.9 V_H)	POD	LAT	36	5.14
1404.0	OGE	SLING LOAD	LAT	36	4.01
1672.0	LDG B	POD	VERT	33	2.32
1912.0	LDG B	POD	VERT	34	8.28
1928.0	OGE	SLING LOAD	LAT	36	22.36
1940.0	OGE	SLING LOAD	VERT	32	6.46

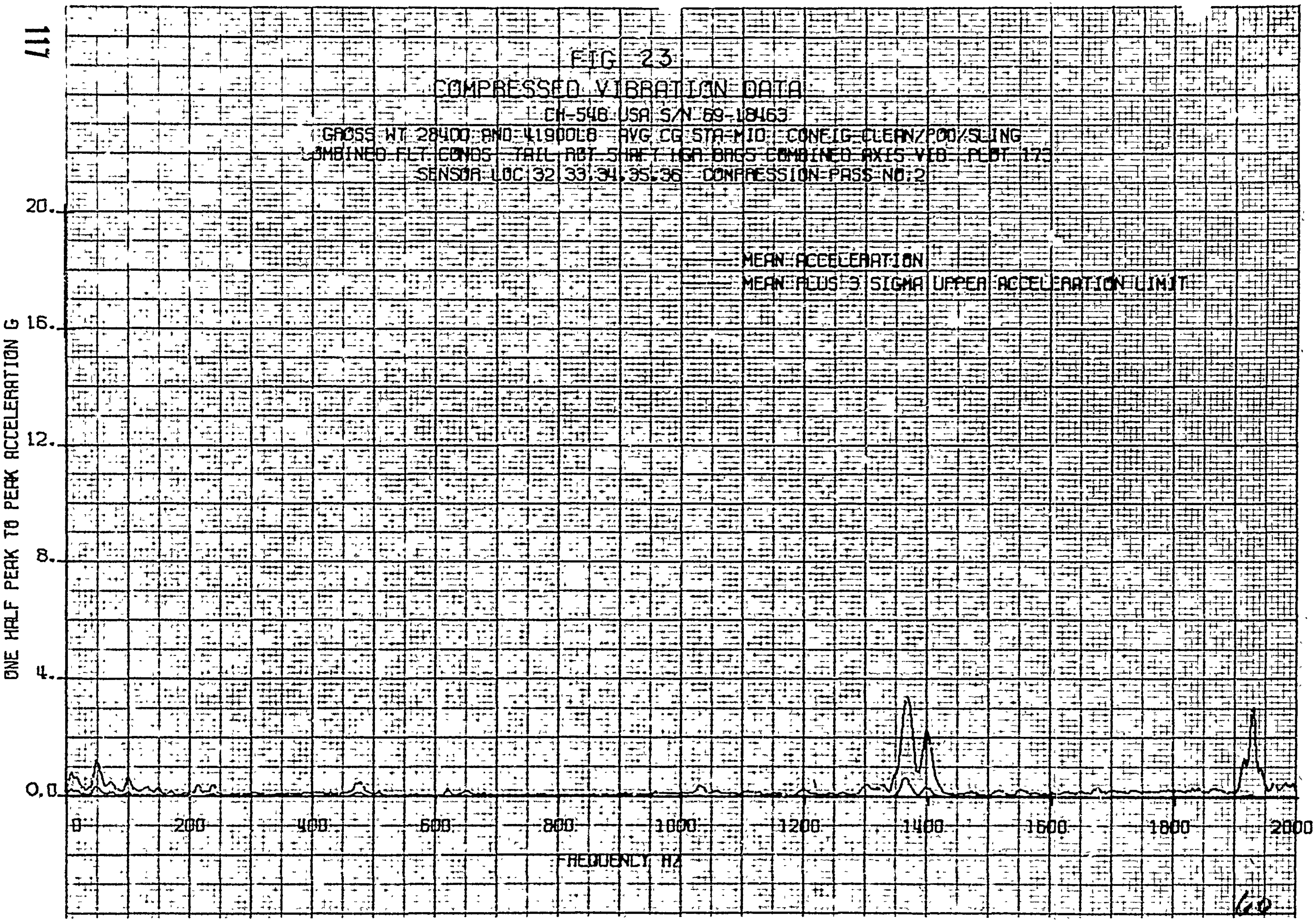


FIG 23
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS TAIL ROT SHAFT HGR BRGS COMBINED AXIS VIB PLOT 173
SENSOR LOC 32 33,34,35,36 COMPRESSION-PASS NO.2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
20.
16.
12.
8.
4.
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ
60

FIG 24

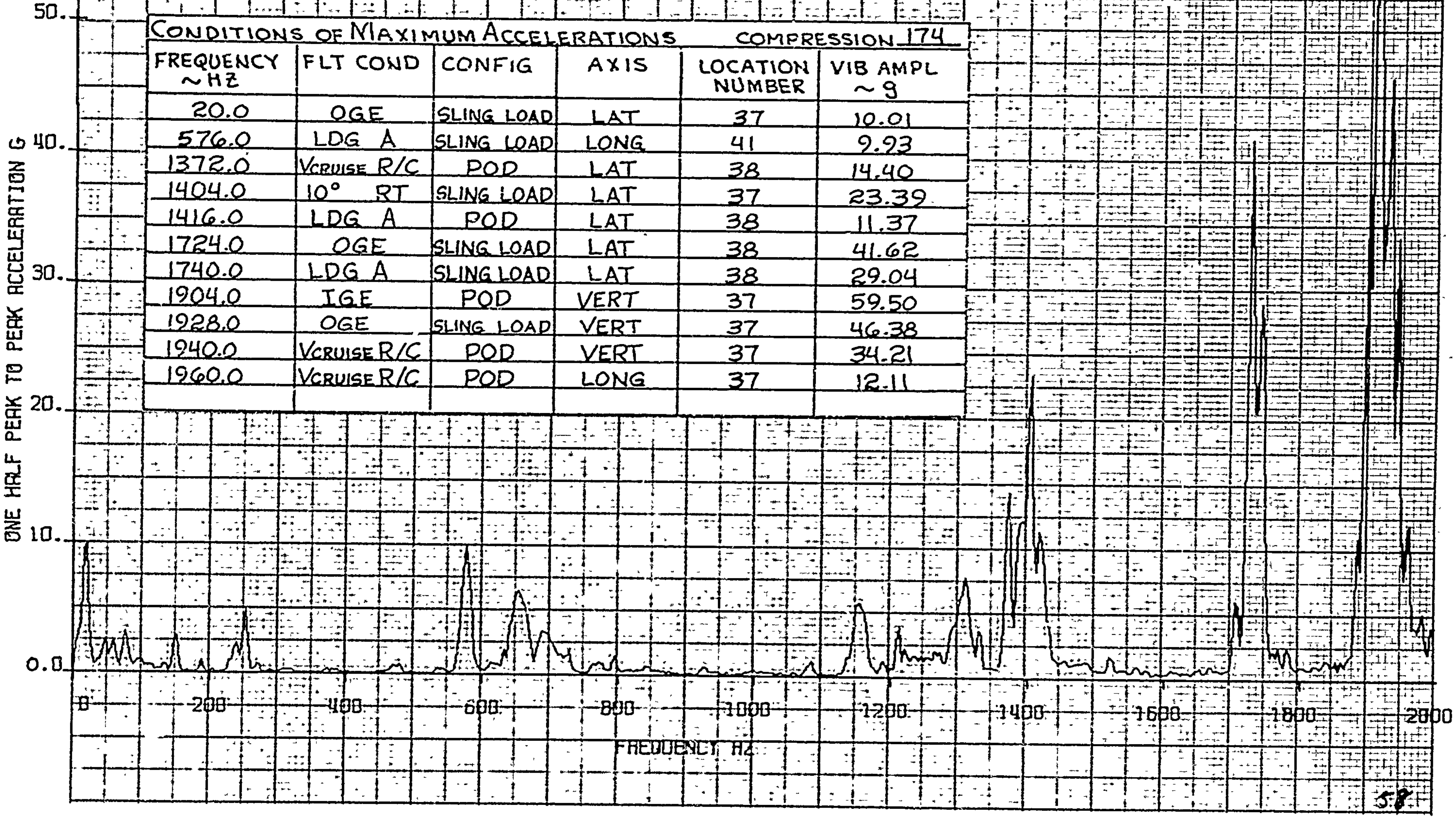
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS HYDRAULIC SYS COMBINED AXIS VIB PLOT 174

SENSOR LOC 37,38,39,40,41,55 COMPRESSION PASS NO.2



CONDITIONS OF MAXIMUM ACCELERATIONS COMPRESSION 174

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
20.0	OGE	SLING LOAD	LAT	37	10.01
576.0	LDG A	SLING LOAD	LONG	41	9.93
1372.0	VCRUISE R/C	POD	LAT	38	14.40
1404.0	10° RT	SLING LOAD	LAT	37	23.39
1416.0	LDG A	POD	LAT	38	11.37
1724.0	OGE	SLING LOAD	LAT	38	41.62
1740.0	LDG A	SLING LOAD	LAT	38	29.04
1904.0	IGE	POD	VERT	37	59.50
1928.0	OGE	SLING LOAD	VERT	37	46.38
1940.0	VCRUISE R/C	POD	VERT	37	34.21
1960.0	VCRUISE R/C	POD	LONG	37	12.11

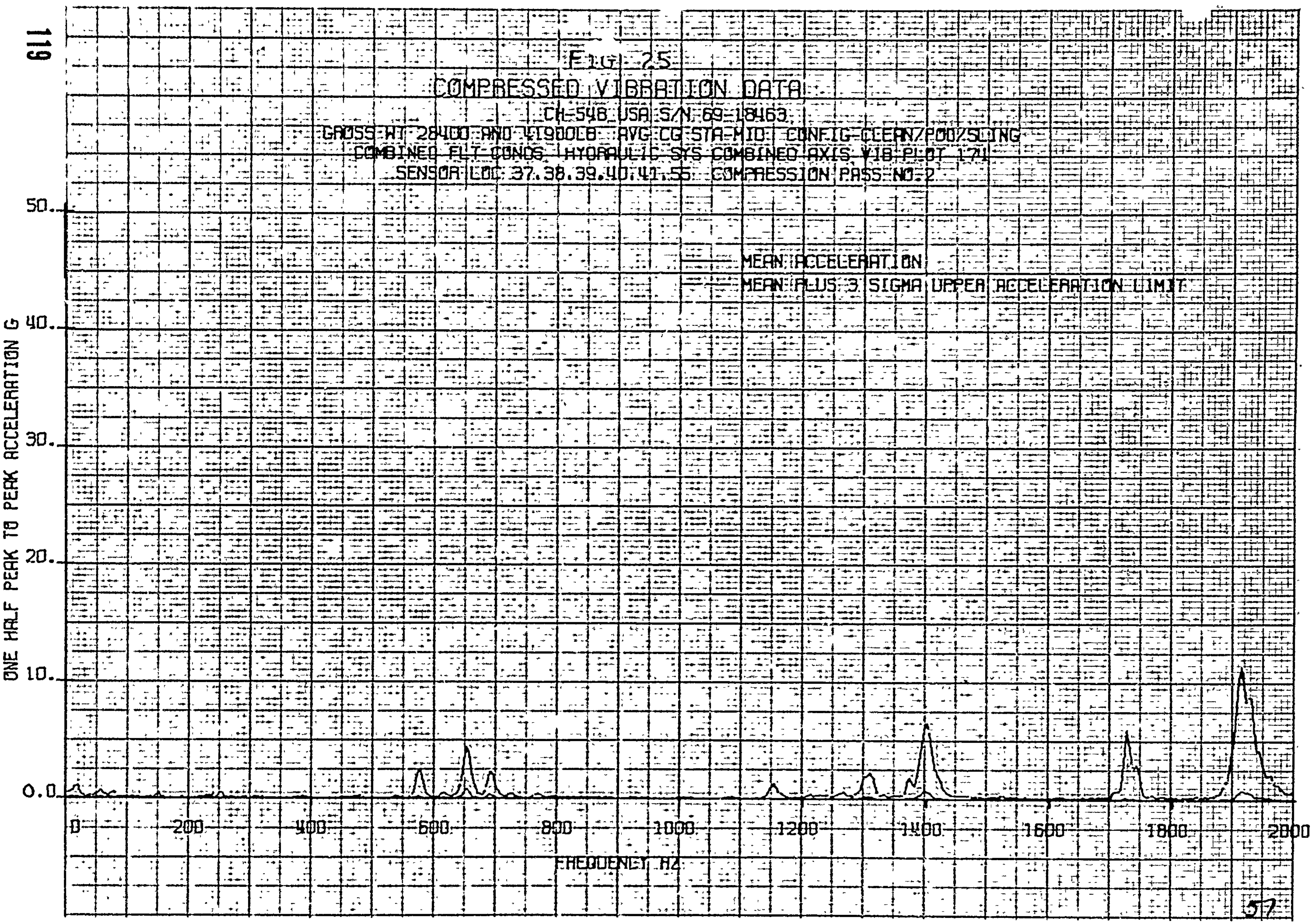


FIG 25
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS HYDRAULIC SYS COMBINED AXIS VIB PLOT 171
SENSOR LOC 37.38.39.40.41.55 COMPRESSION PASS NO 2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
0.0
10.
20.
30.
40.
50.
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ
57

FIG 26

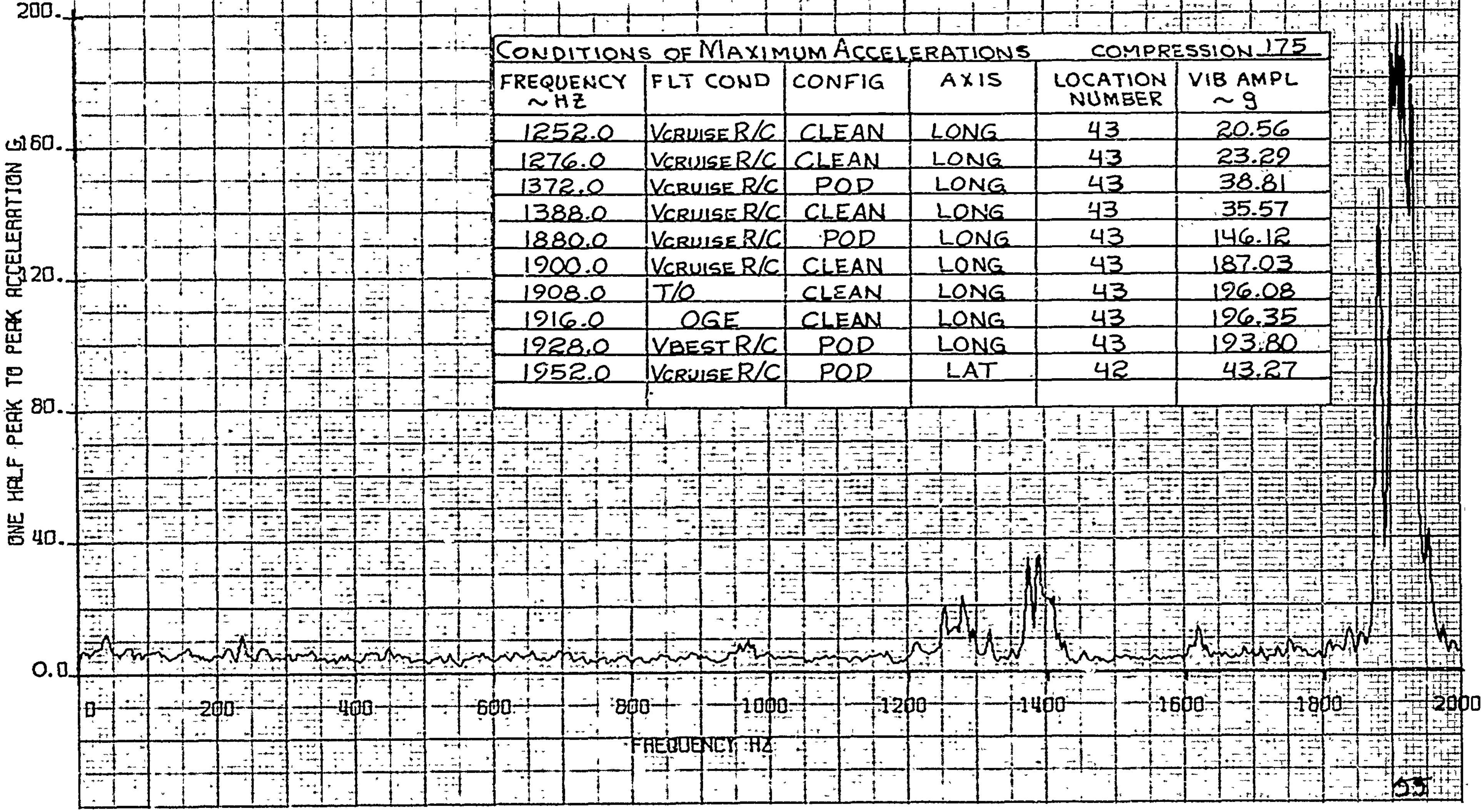
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS OIL COOLER SUPPORT COMBINED AXIS VIB PLOT 175

SENSOR LOC 42,43 COMPRESSION PASS NO.2



CONDITIONS OF MAXIMUM ACCELERATIONS — COMPRESSION 175

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
1252.0	VCRUISE R/C	CLEAN	LONG	43	20.56
1276.0	VCRUISE R/C	CLEAN	LONG	43	23.29
1372.0	VCRUISE R/C	POD	LONG	43	38.81
1388.0	VCRUISE R/C	CLEAN	LONG	43	35.57
1880.0	VCRUISE R/C	POD	LONG	43	146.12
1900.0	VCRUISE R/C	CLEAN	LONG	43	187.03
1908.0	T/O	CLEAN	LONG	43	196.08
1916.0	OGE	CLEAN	LONG	43	196.35
1928.0	VBEST R/C	POD	LONG	43	193.80
1952.0	VCRUISE R/C	POD	LAT	42	43.27

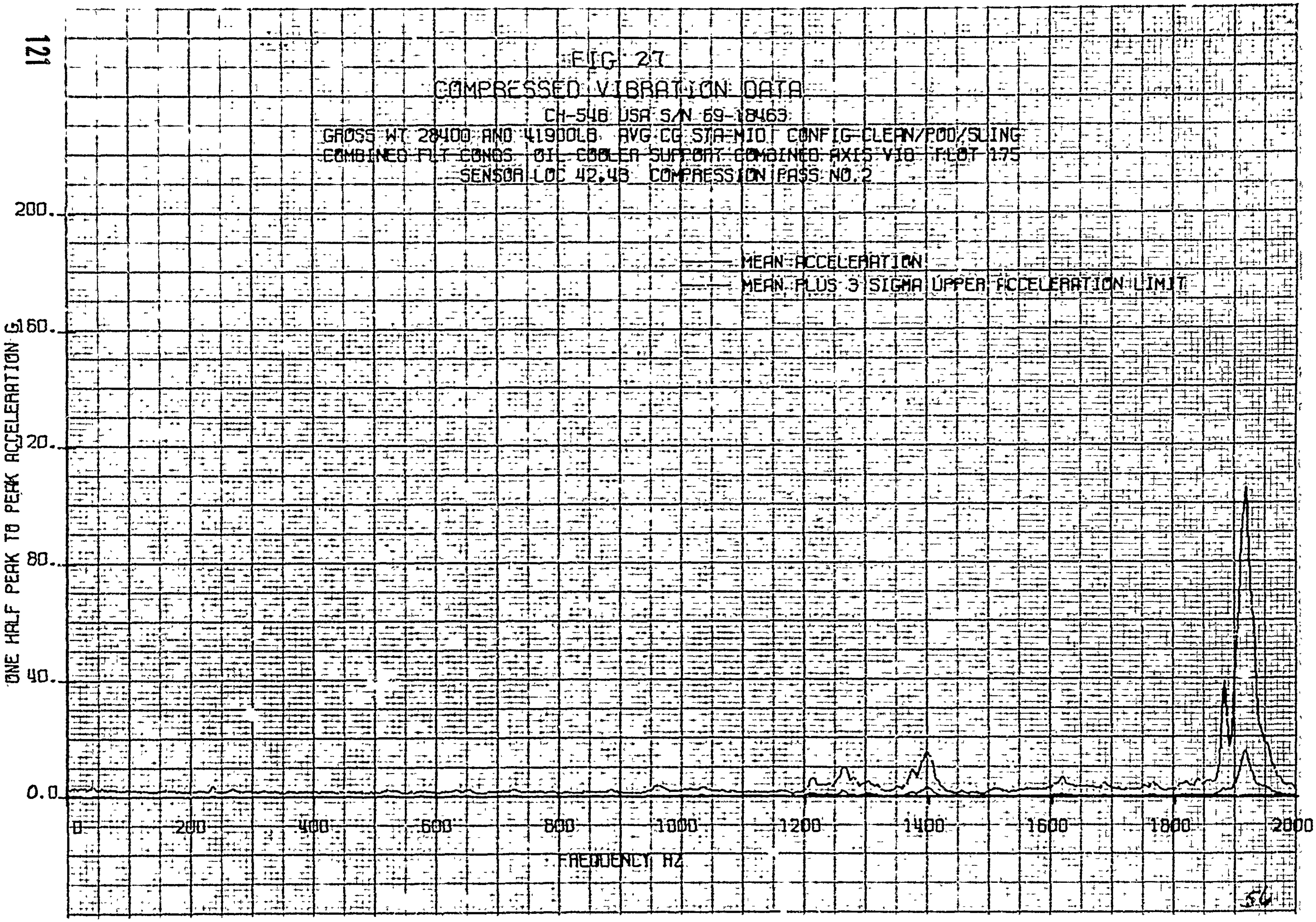


FIG 27
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS OIL COOLER SUPPORT COMBINED AXIS V10 PLOT 175
SENSOR LOC 42.4B COMPRESSION PASS NO.2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
200.
160.
120.
80.
40.
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ
56

FIG 28

COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

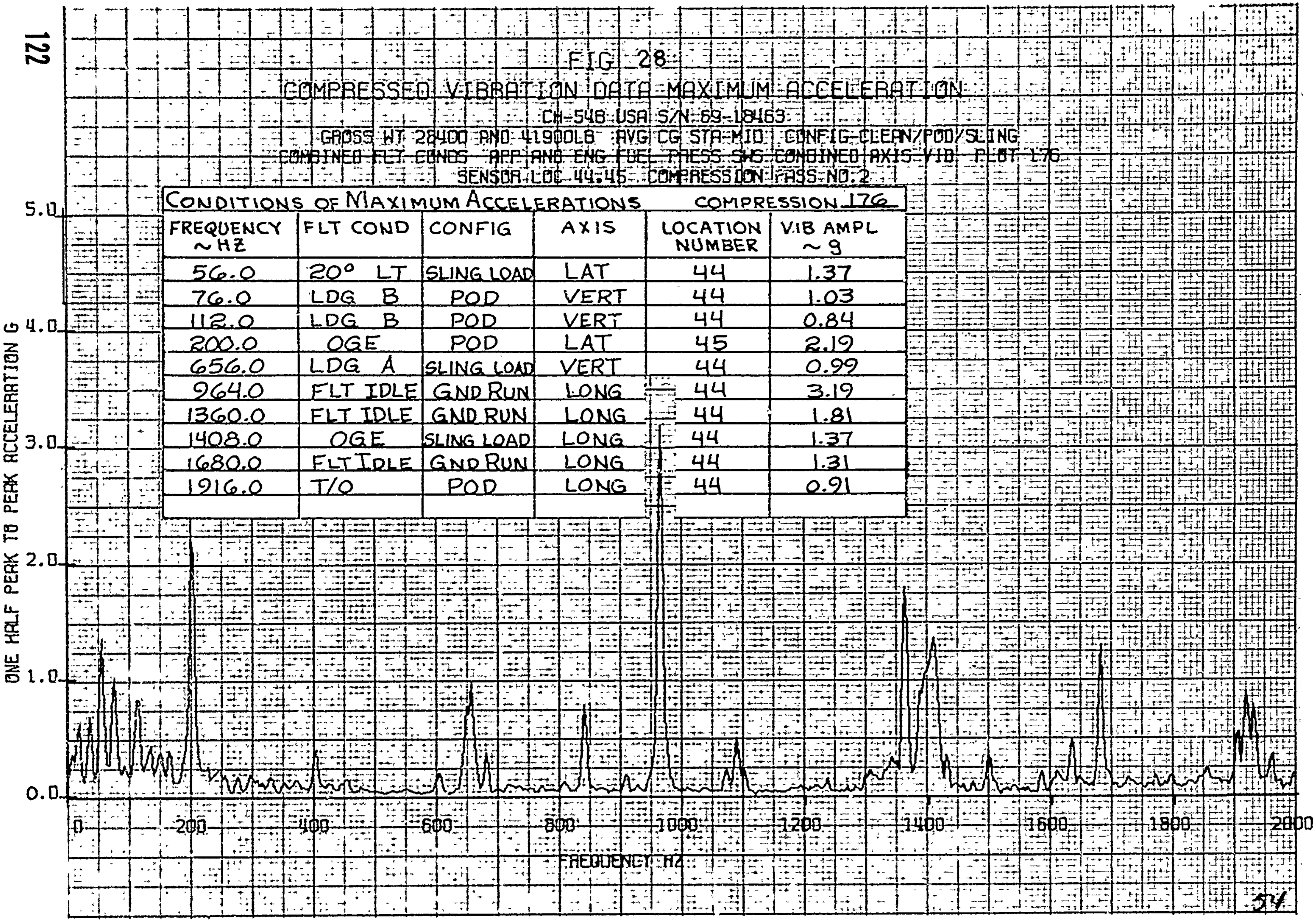
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS APP AND ENG FUEL PRESS SWS COMBINED AXIS VIB PLOT 176

SENSOR LOC 44.45 COMPRESSION PASS NO.2

CONDITIONS OF MAXIMUM ACCELERATIONS COMPRESSION 176

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
56.0	20° LT	SLING LOAD	LAT	44	1.37
76.0	LDG B	POD	VERT	44	1.03
112.0	LDG B	POD	VERT	44	0.84
200.0	OGE	POD	LAT	45	2.19
656.0	LDG A	SLING LOAD	VERT	44	0.99
964.0	FLT IDLE	GND RUN	LONG	44	3.19
1360.0	FLT IDLE	GND RUN	LONG	44	1.81
1408.0	OGE	SLING LOAD	LONG	44	1.37
1680.0	FLT IDLE	GND RUN	LONG	44	1.31
1916.0	T/O	POD	LONG	44	0.91



54

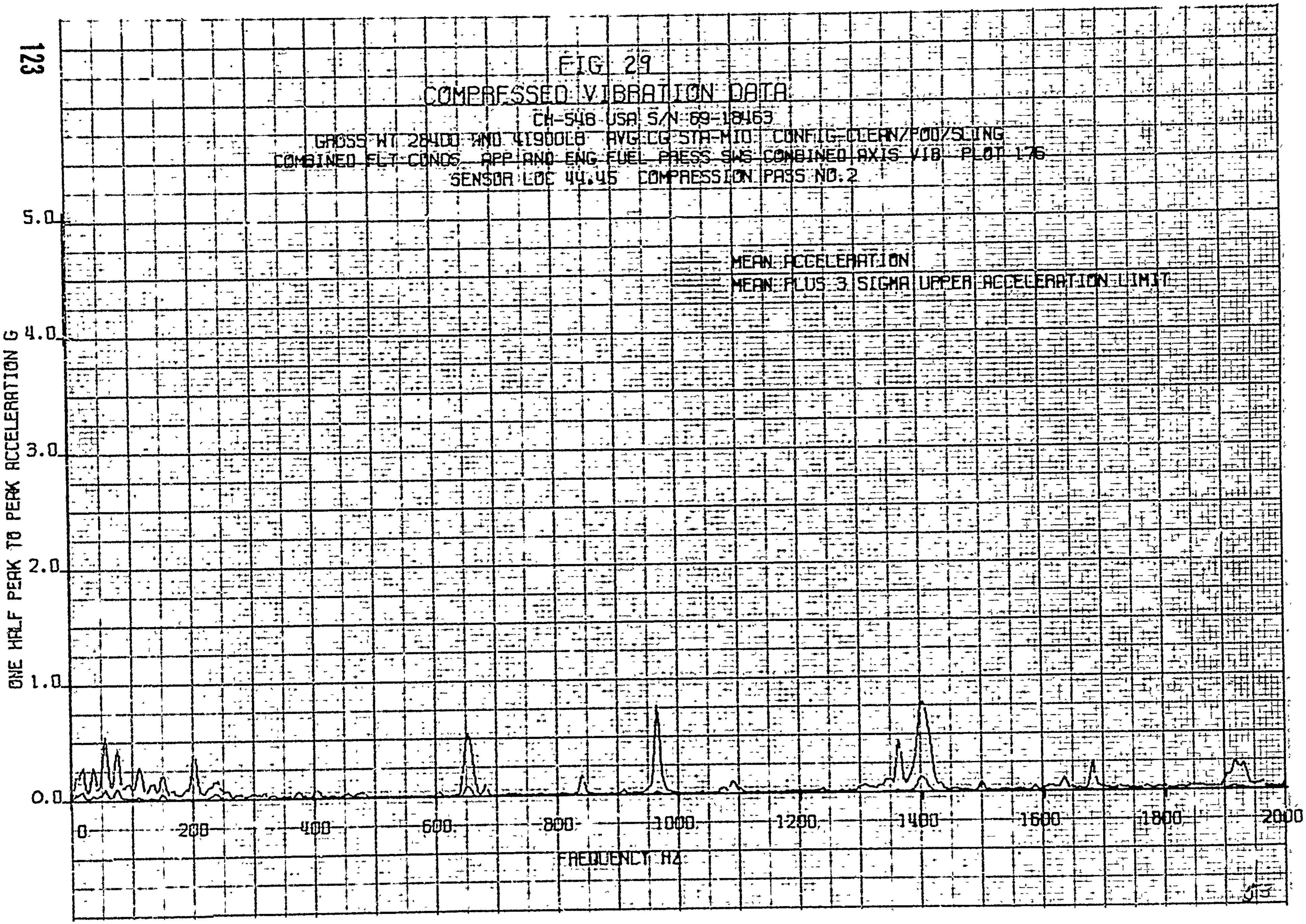


FIG 29
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS APP AND ENG FUEL PRESS SWS COMBINED AXIS VIB PLOT 176
SENSOR LOC 44.45 COMPRESSION PASS NO.2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
5.0
4.0
3.0
2.0
1.0
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

FIG 30

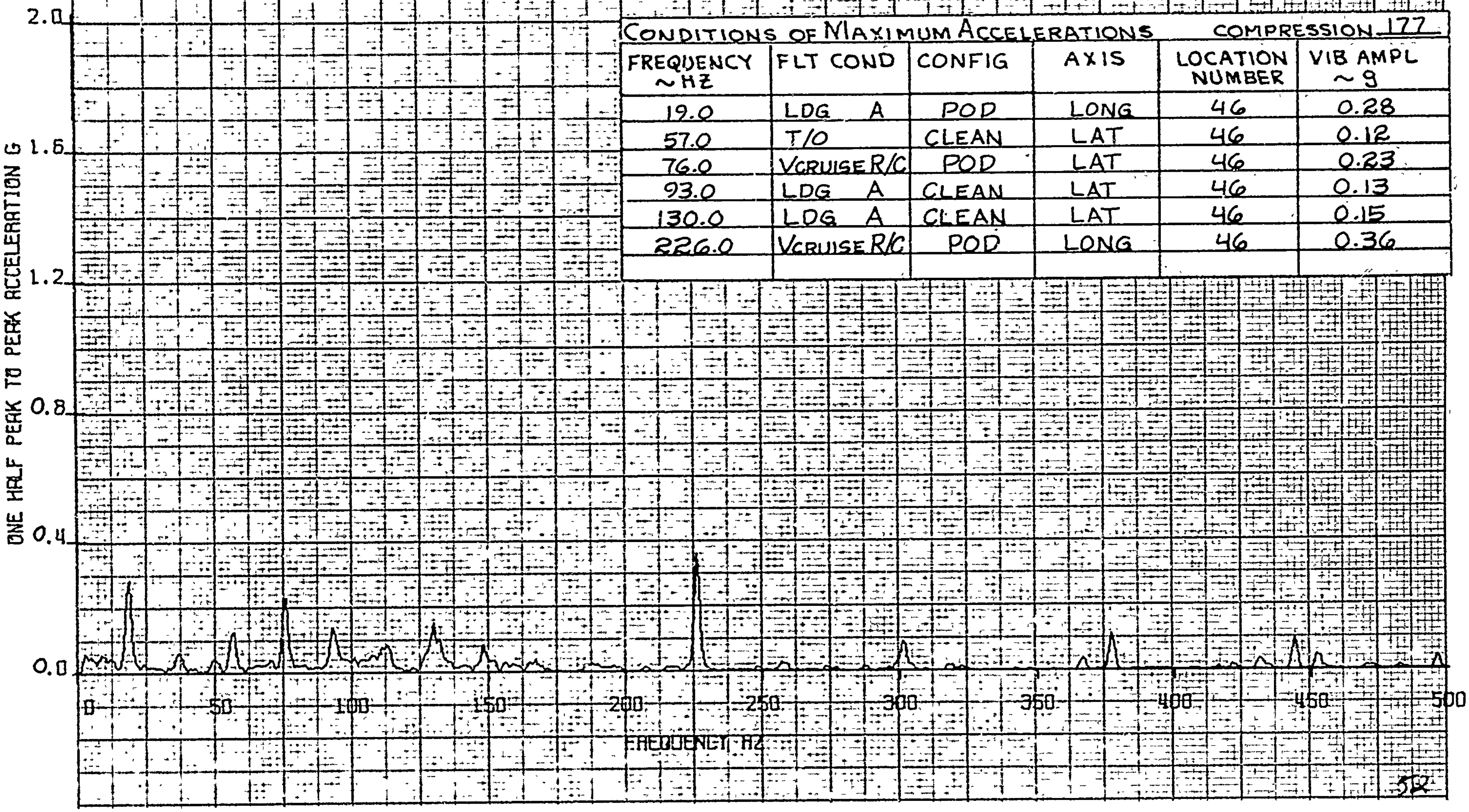
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS BRAKE CYL COMBINED AXIS VIB PLOT 177

SENSOR LOC 46 COMPRESSION PASS NO 2



CONDITIONS OF MAXIMUM ACCELERATIONS COMPRESSION 177

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
19.0	LDG A	POD	LONG	46	0.28
57.0	T/O	CLEAN	LAT	46	0.12
76.0	VCRUISE R/C	POD	LAT	46	0.23
93.0	LDG A	CLEAN	LAT	46	0.13
130.0	LDG A	CLEAN	LAT	46	0.15
226.0	VCRUISE R/C	POD	LONG	46	0.36

52

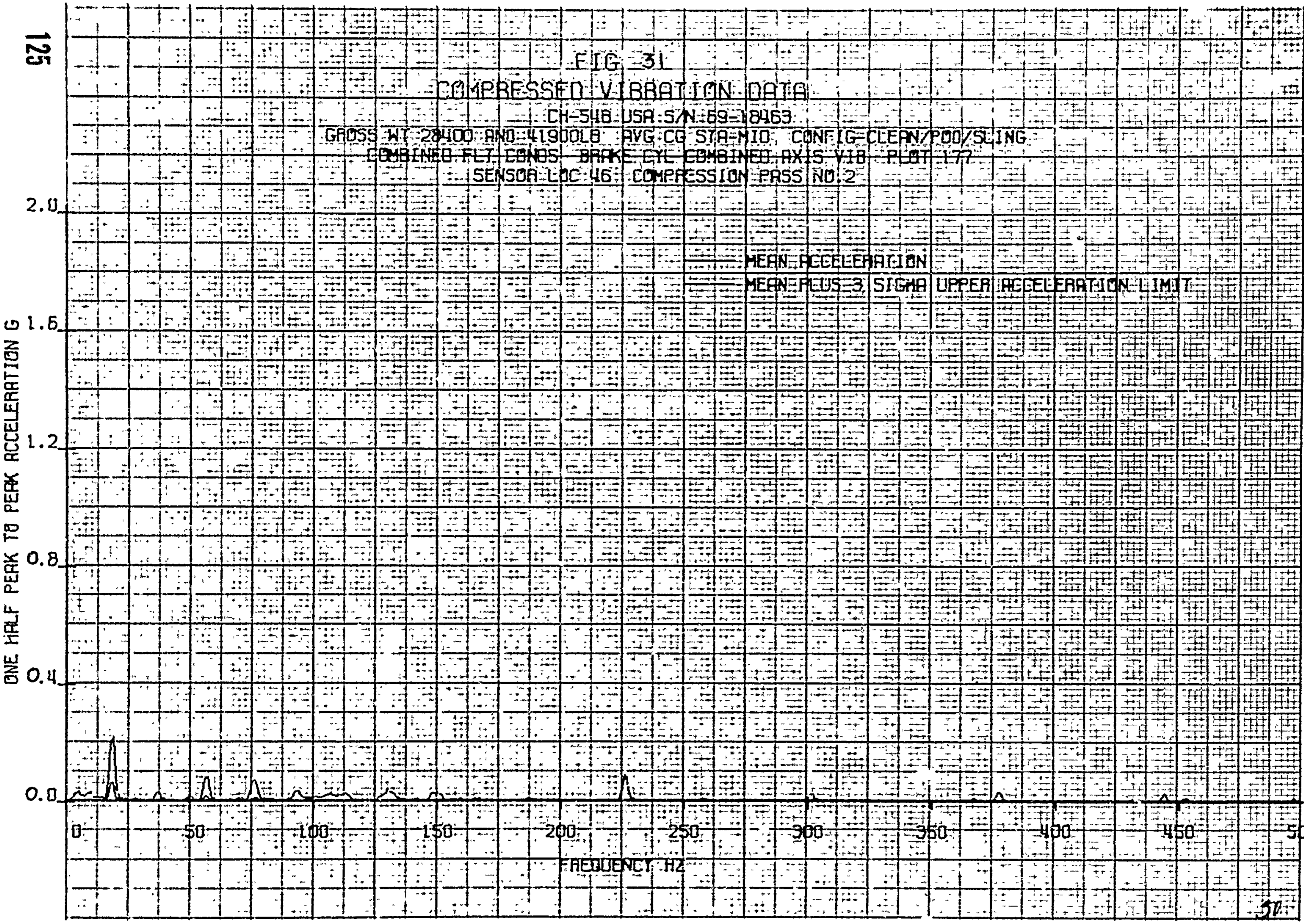


FIG. 31
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS BRAKE CYL COMBINED AXIS VIB PLOT 177
SENSOR LOC 46 COMPRESSION PASS NO.2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ
57

FIG 32

COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

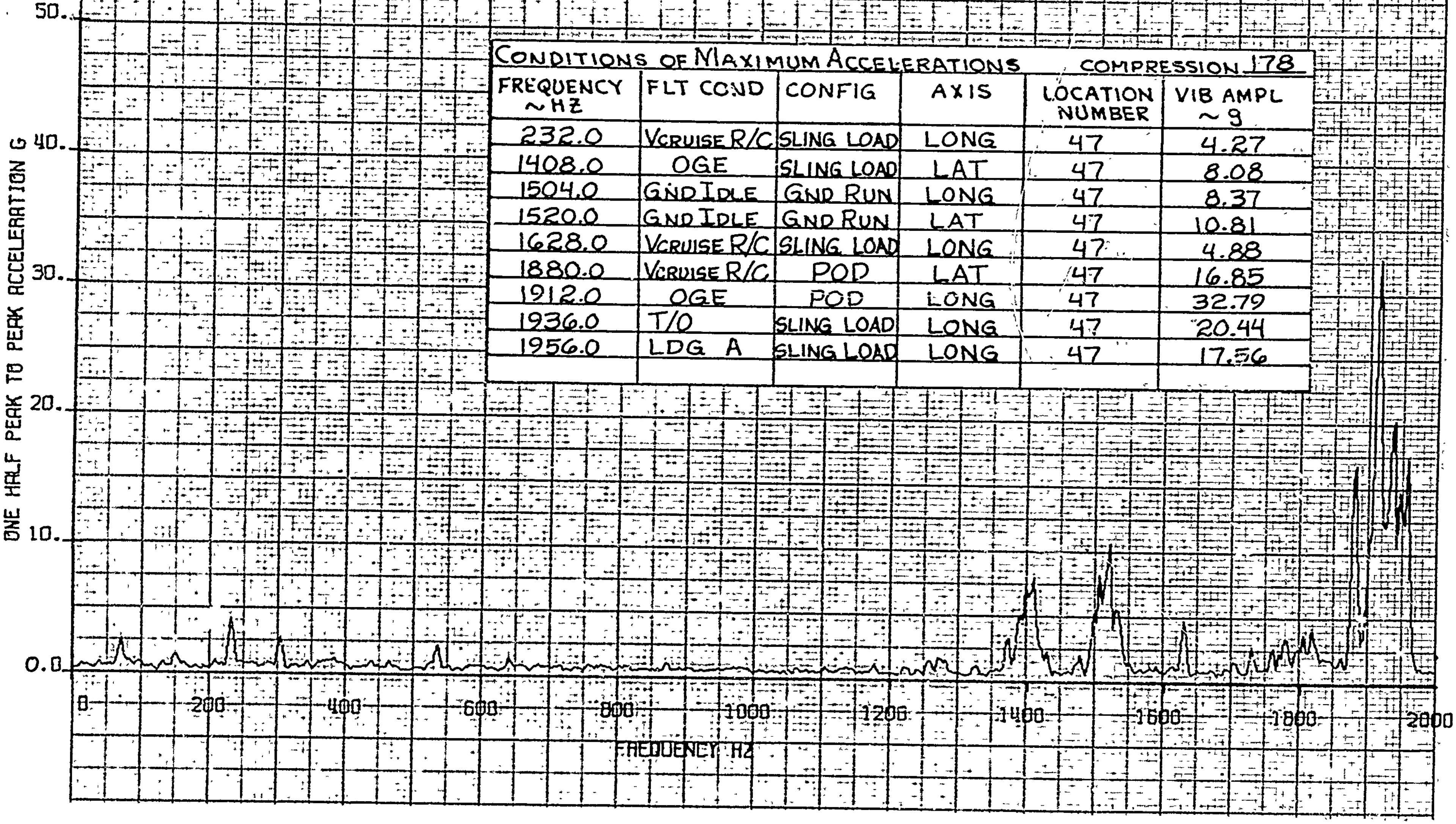
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS ROTOR BRAKE SUPPORT COMBINED AXIS VIB PLOT 178

SENSOR LOC 47 COMPRESSION PASS NO 2

CONDITIONS OF MAXIMUM ACCELERATIONS — COMPRESSION 178

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
232.0	VCRUISE R/C	SLING LOAD	LONG	47	4.27
1408.0	OGE	SLING LOAD	LAT	47	8.08
1504.0	GND IDLE	GND RUN	LONG	47	8.37
1520.0	GND IDLE	GND RUN	LAT	47	10.81
1628.0	VCRUISE R/C	SLING LOAD	LONG	47	4.88
1880.0	VCRUISE R/C	POD	LAT	47	16.85
1912.0	OGE	POD	LONG	47	32.79
1936.0	T/O	SLING LOAD	LONG	47	20.44
1956.0	LDG A	SLING LOAD	LONG	47	17.56



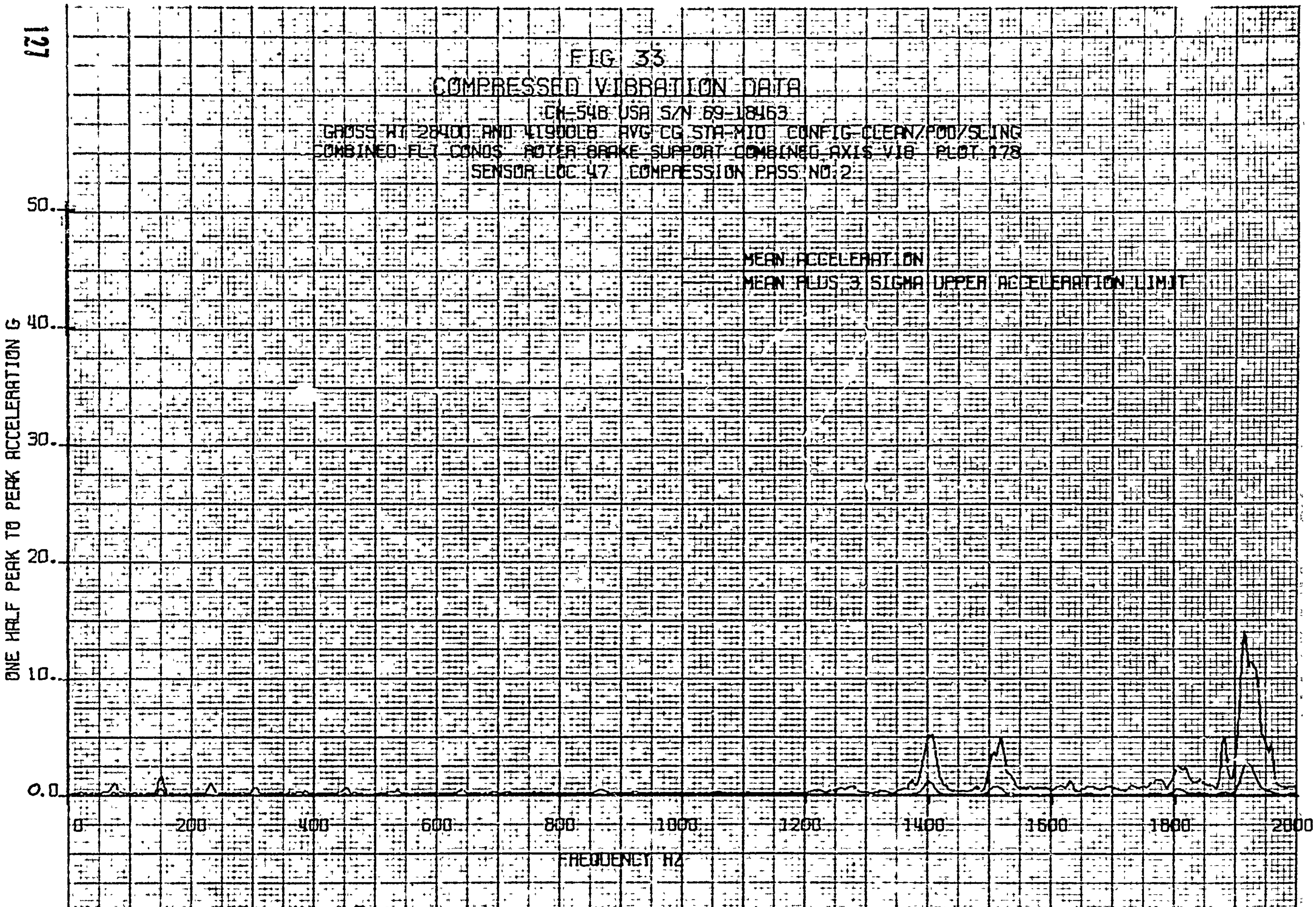


FIG 33
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS ROTOR BRAKE SUPPORT COMBINED AXIS V18 PLOT 178
SENSOR LOC 47 COMPRESSION PASS NO 2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
50.
40.
30.
20.
10.
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

FIG 34

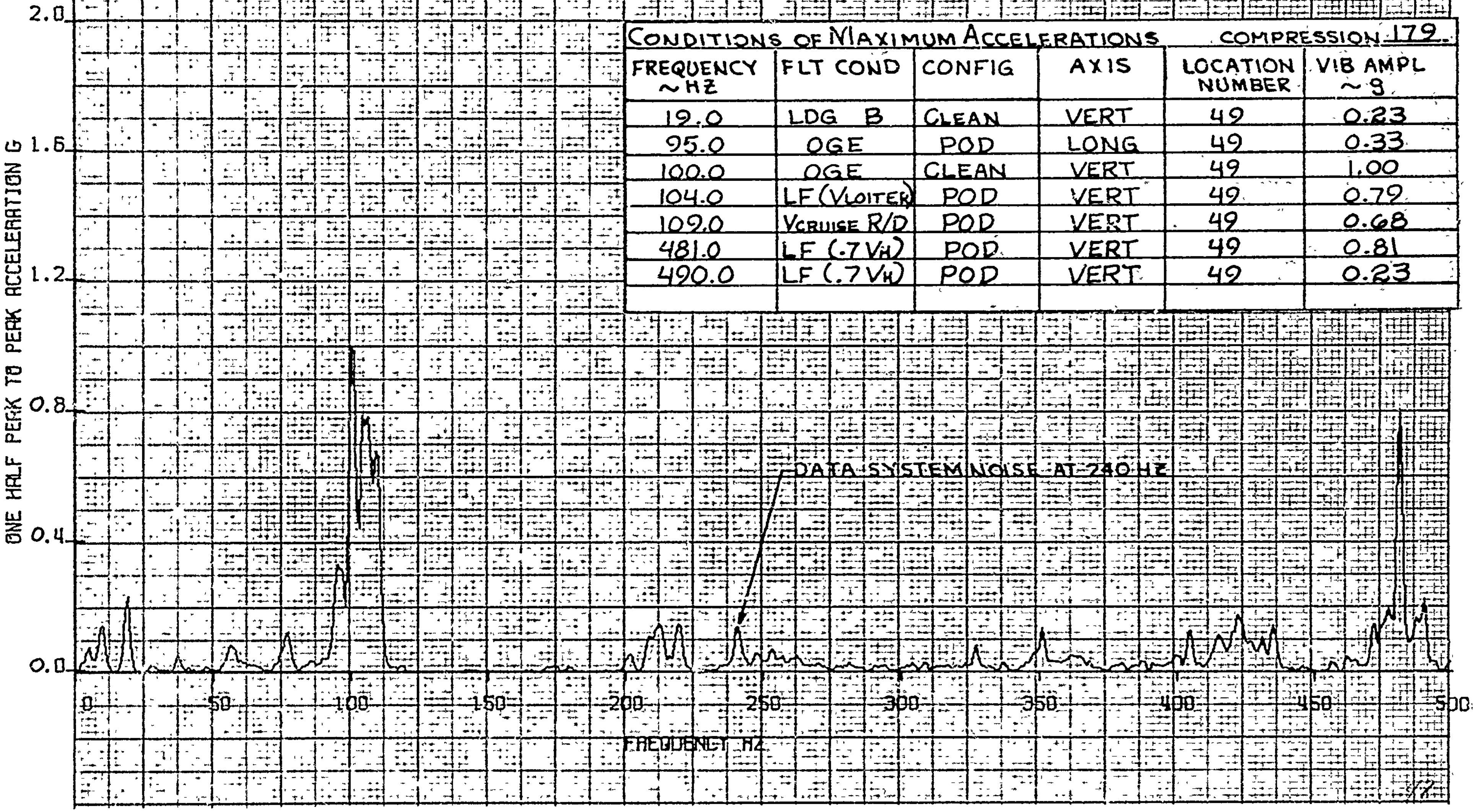
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS COCKPIT BLOWER COMBINED AXIS VIB PLOT 179

SENSOR LOC 49 COMPRESS PASS NO.2



CONDITIONS OF MAXIMUM ACCELERATIONS — COMPRESSION 179

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
19.0	LDG B	CLEAN	VERT	49	0.23
95.0	OGE	POD	LONG	49	0.33
100.0	OGE	CLEAN	VERT	49	1.00
104.0	LF (V_{LOITER})	POD	VERT	49	0.79
109.0	V_{CRUISE} R/D	POD	VERT	49	0.68
481.0	LF (.7 V_H)	POD	VERT	49	0.81
490.0	LF (.7 V_H)	POD	VERT	49	0.23

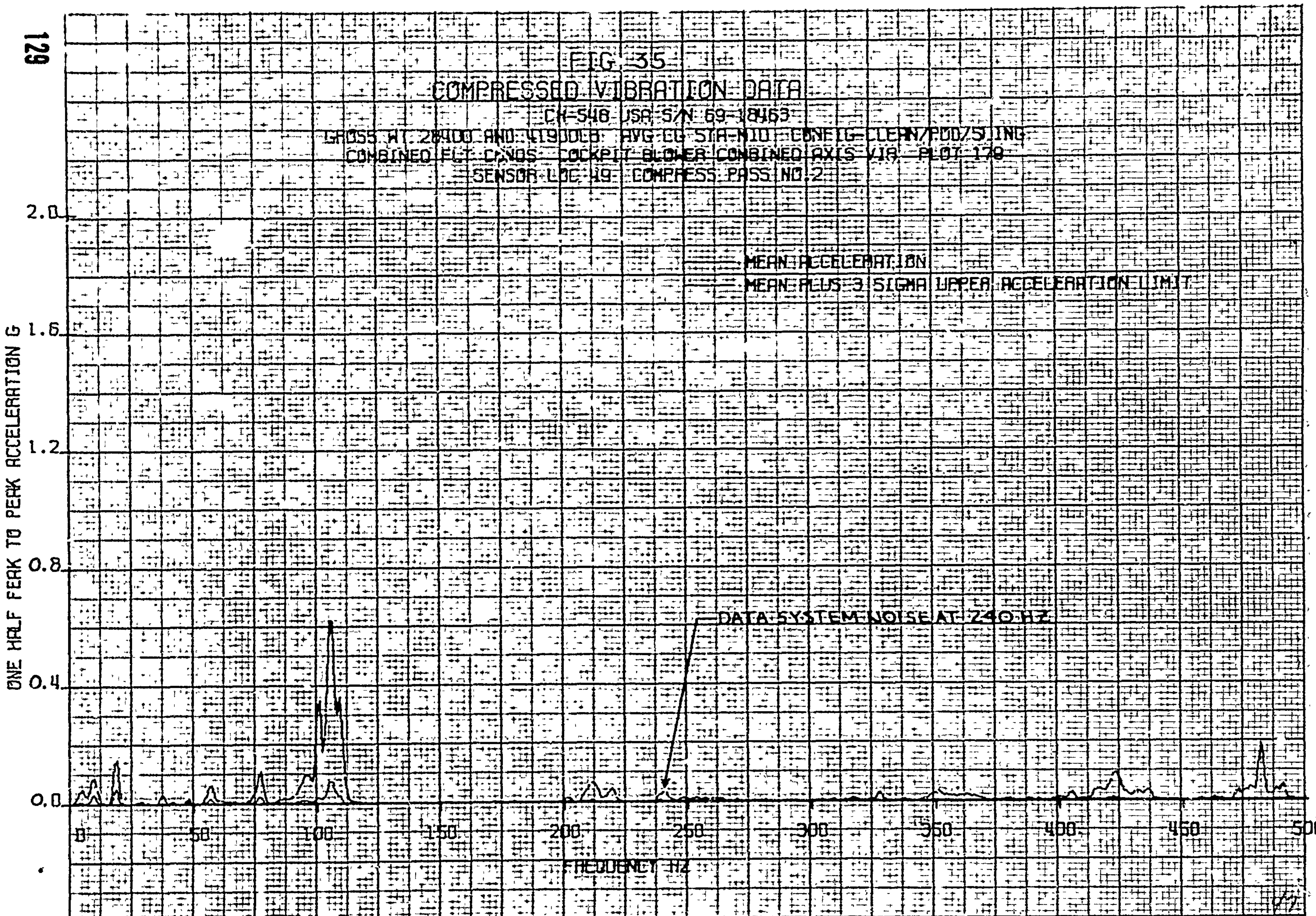
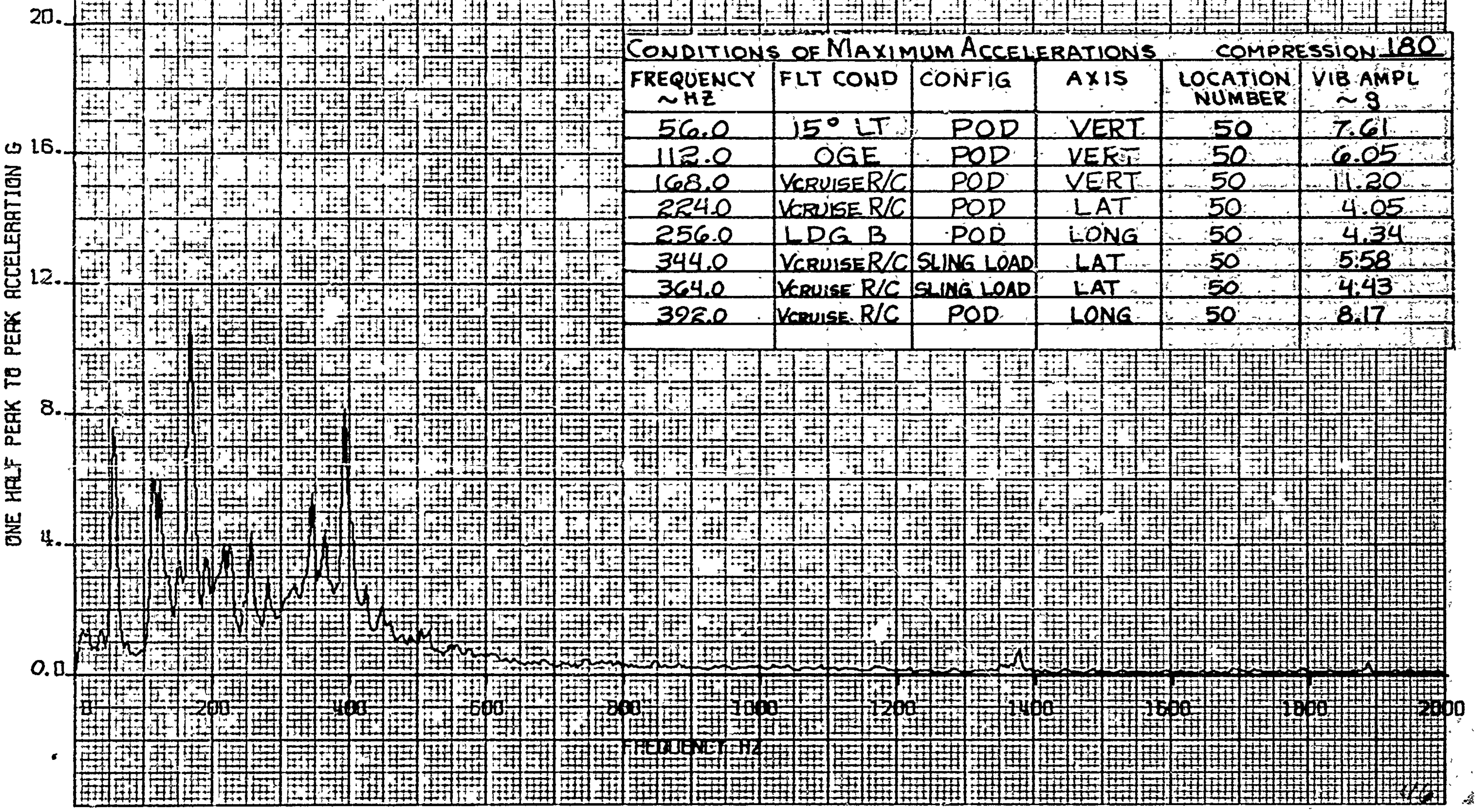


FIG 35
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CNDS COCKPIT BLOWER COMBINED AXIS VIB PLOT 178
SENSOR LOC 49 COMPRESS PASS NO.2

FIG 36
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-410 CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS HORIZ STABILIZER COMBINED AXIS VIB PLOT 180
SENSOR LOC 50 COMPRESSION PASS NO 2



CONDITIONS OF MAXIMUM ACCELERATIONS COMPRESSION 180

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
56.0	15° LT	POD	VERT	50	7.61
112.0	OGE	POD	VERT	50	6.05
168.0	VCRUISE R/C	POD	VERT	50	11.20
224.0	VCRUISE R/C	POD	LAT	50	4.05
256.0	LDG B	POD	LONG	50	4.34
344.0	VCRUISE R/C	SLING LOAD	LAT	50	5.58
364.0	VCRUISE R/C	SLING LOAD	LAT	50	4.43
392.0	VCRUISE R/C	POD	LONG	50	8.17

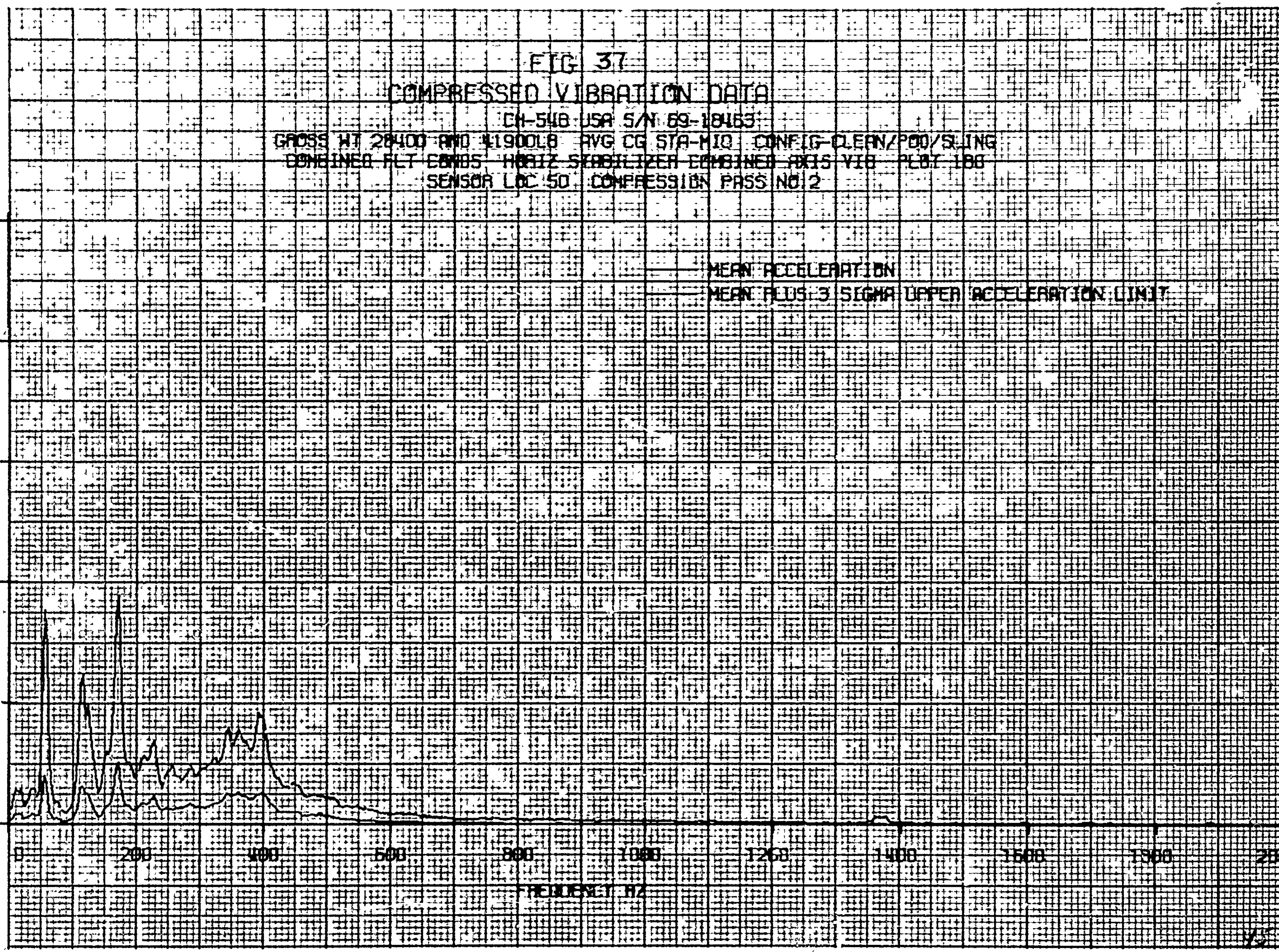


FIG 37
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 20400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS HORIZ STABILIZER COMBINED AXIS VIB PLOT 188
SENSOR LOC 50 COMPRESSION PASS NO 2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
20.
16.
12.
8.
4.
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

FIG 38

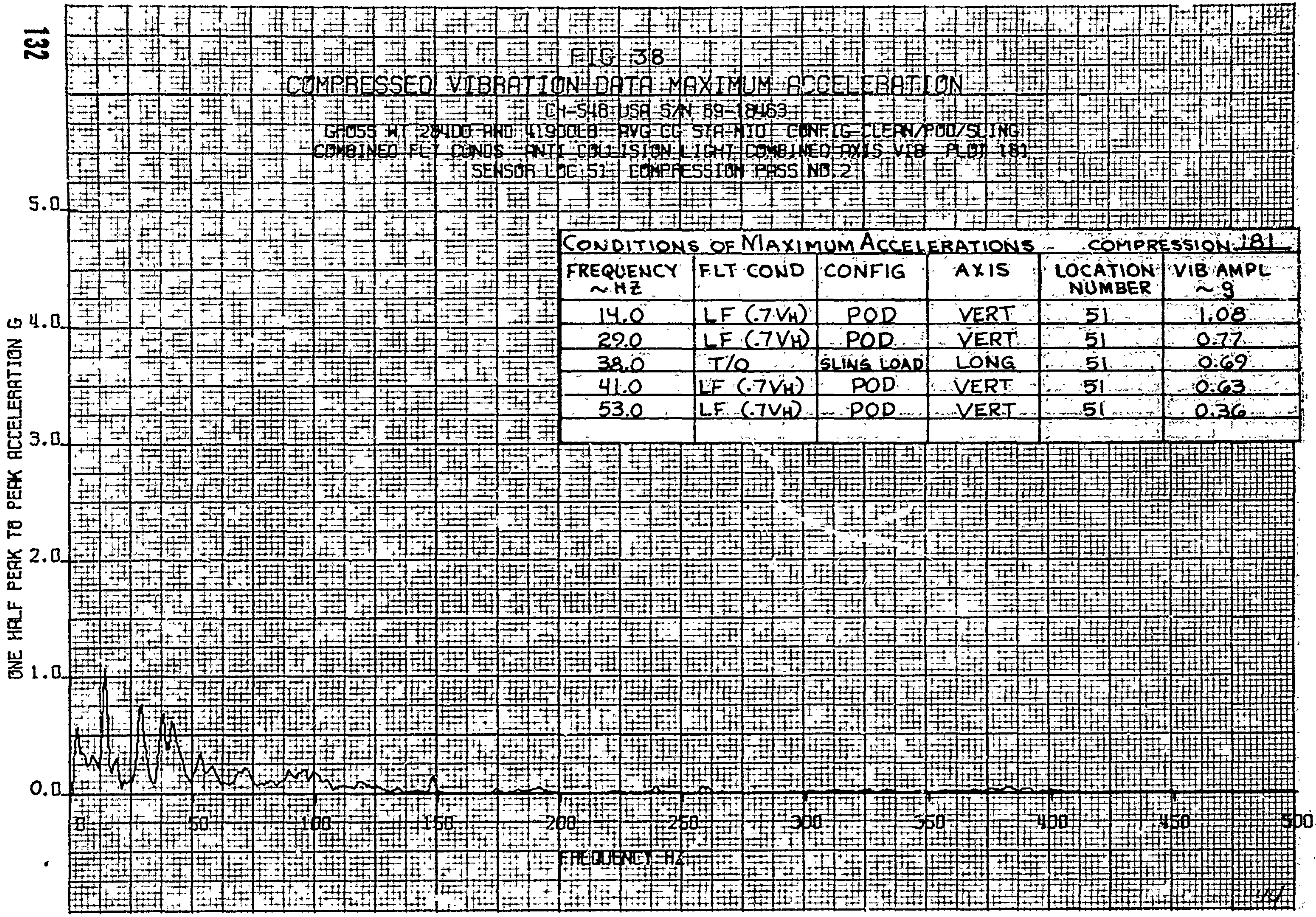
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS ANTI COLLISION LIGHT COMBINED AXIS VIB PLOT 181

SENSOR LOC 51 COMPRESSION PASS NO 2



CONDITIONS OF MAXIMUM ACCELERATIONS — COMPRESSION 181

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
14.0	LF (.7VH)	POD	VERT	51	1.08
29.0	LF (.7VH)	POD	VERT	51	0.77
38.0	T/O	SLING LOAD	LONG	51	0.69
41.0	LF (.7VH)	POD	VERT	51	0.63
53.0	LF (.7VH)	POD	VERT	51	0.36

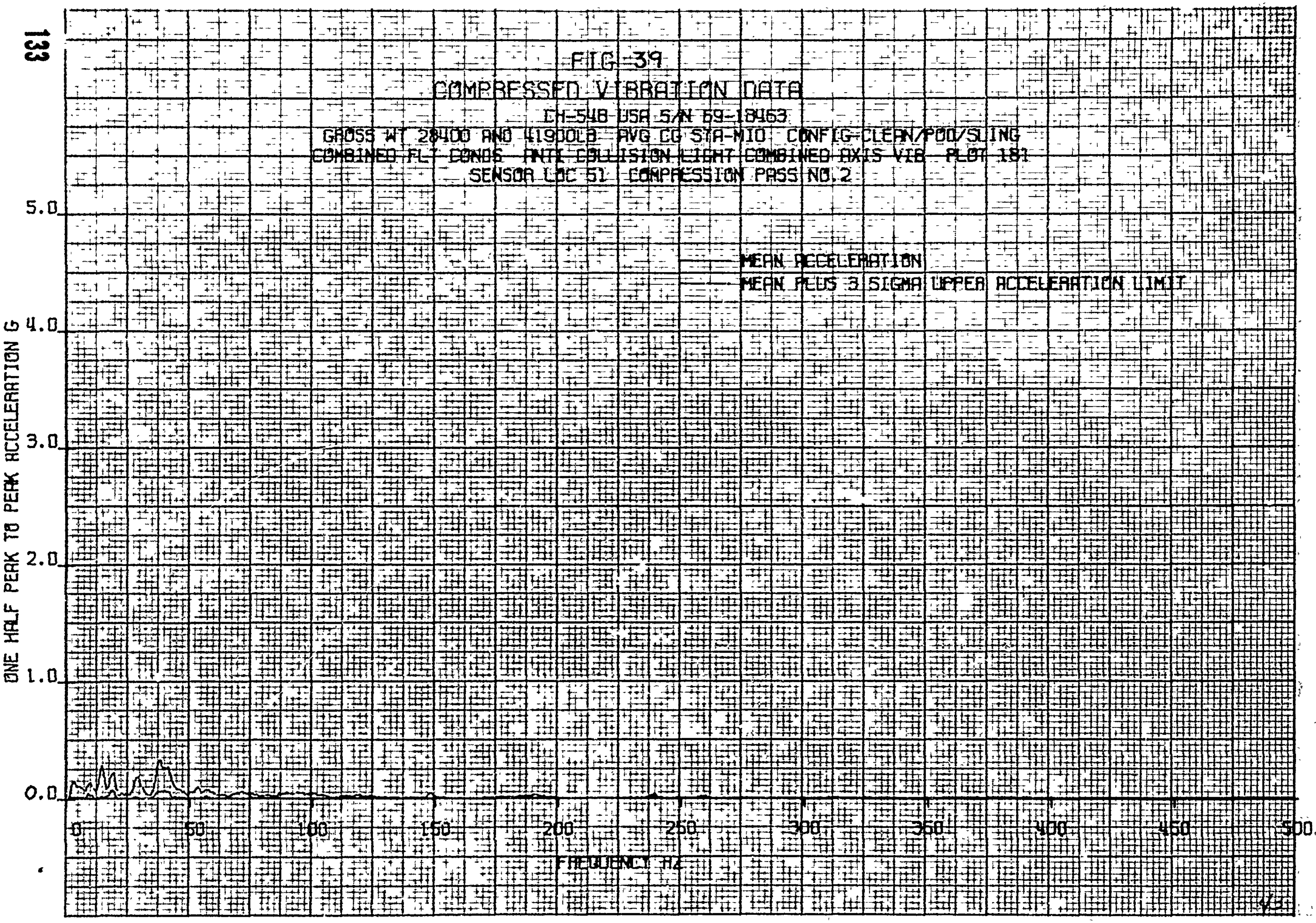


FIG-39
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS ANTI COLLISION LIGHT COMBINED AXIS VIB PLOT 181
SENSOR LOC 51 COMPRESSION PASS NO.2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
5.0
4.0
3.0
2.0
1.0
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

FIG 40

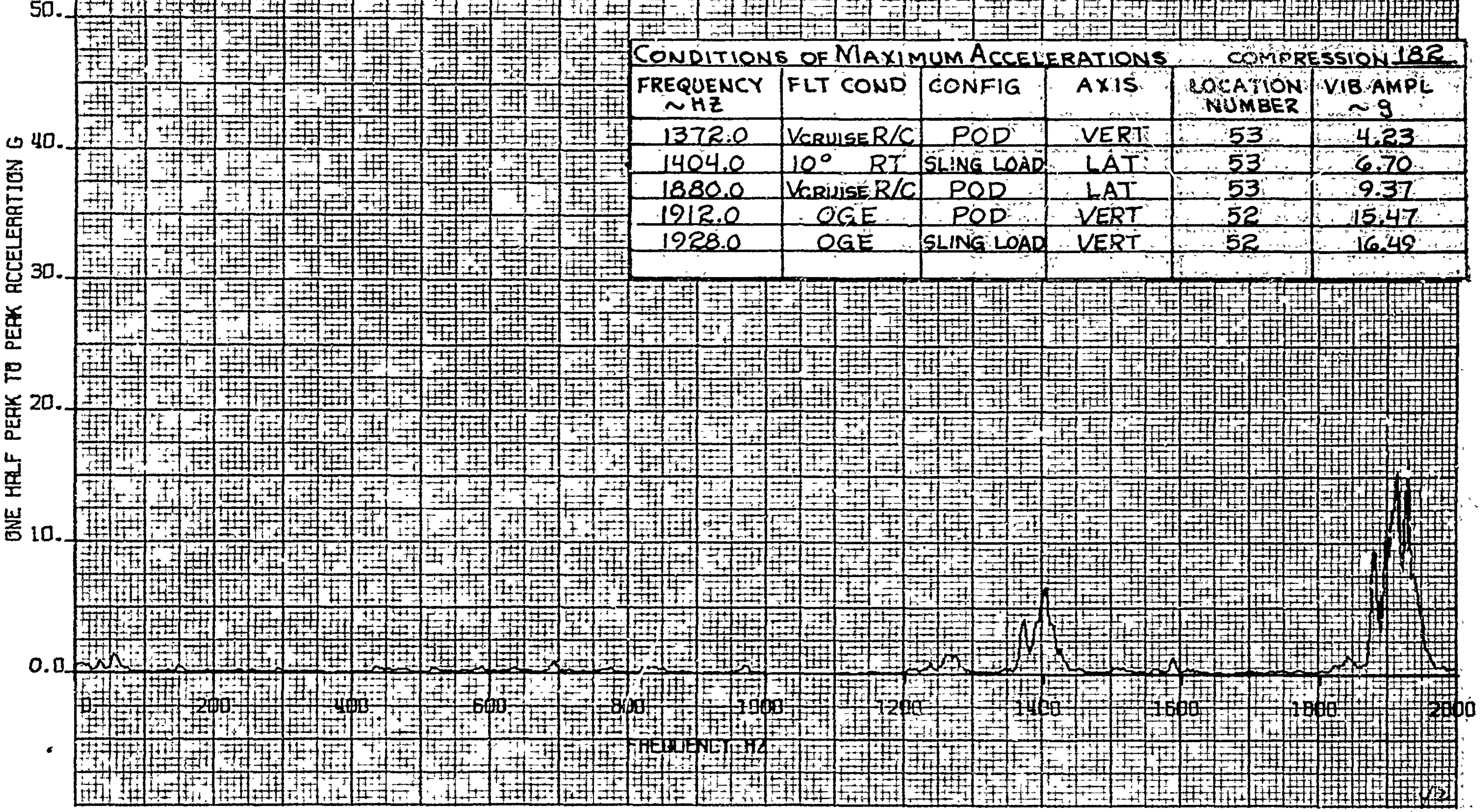
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18433

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS PRI SERVO ACTUATORS COMBINED AXIS VIB PLOT 182

SENSOR LOC 52,53 COMPRESSION PASS NO 2



CONDITIONS OF MAXIMUM ACCELERATIONS — COMPRESSION 182

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
1372.0	V_{CRUISE} R/C	POD	VERT	53	4.23
1404.0	10° RT	SLING LOAD	LAT	53	6.70
1880.0	V_{CRUISE} R/C	POD	LAT	53	9.37
1912.0	OGE	POD	VERT	52	15.47
1928.0	OGE	SLING LOAD	VERT	52	16.49

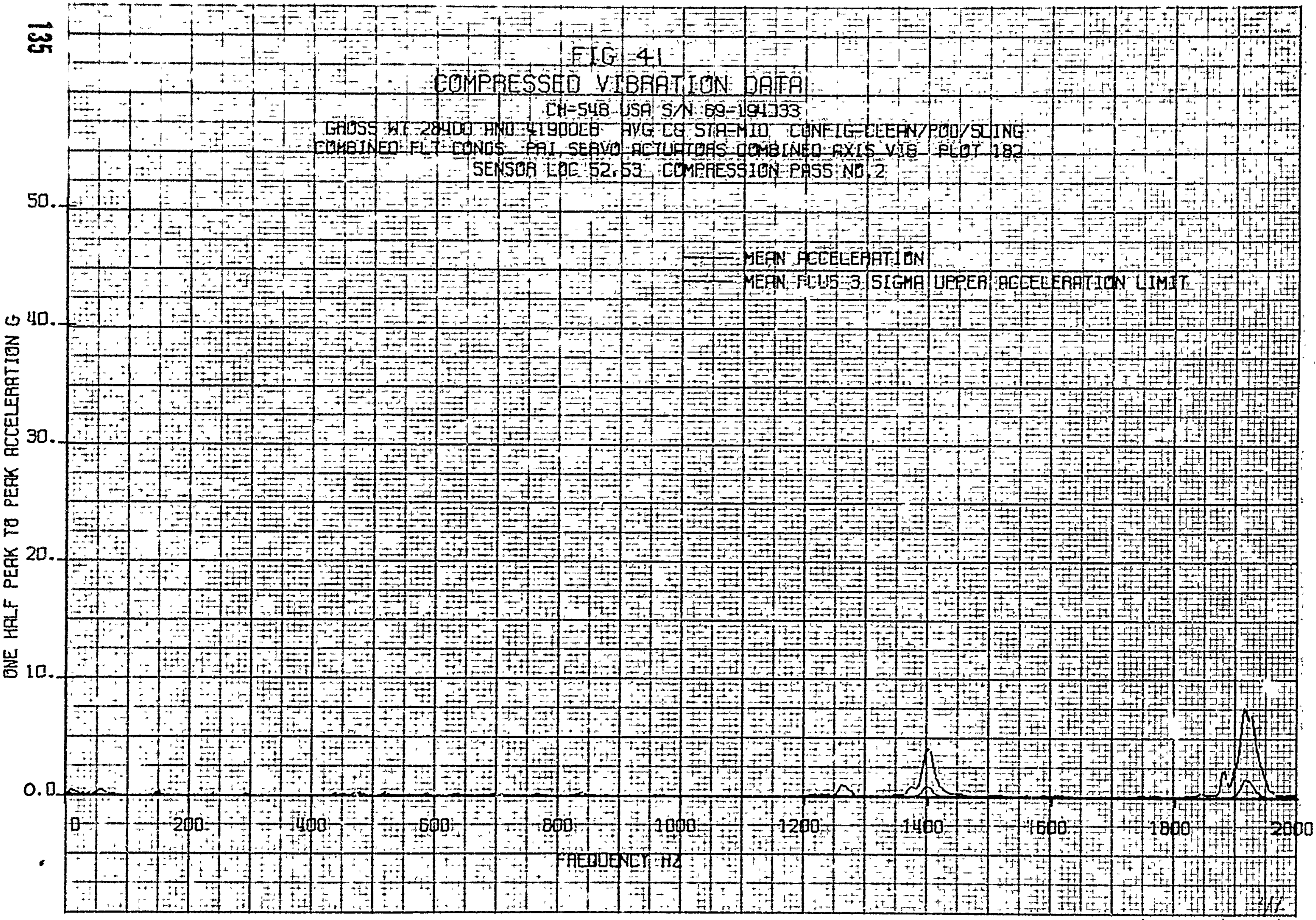


FIG 41
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18433
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS PAI SERVO ACTUATORS COMBINED AXIS V18 PLOT 182
SENSOR LOC 52,53 COMPRESSION PASS NO 2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
50.
40.
30.
20.
10.
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

FIG 42

COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

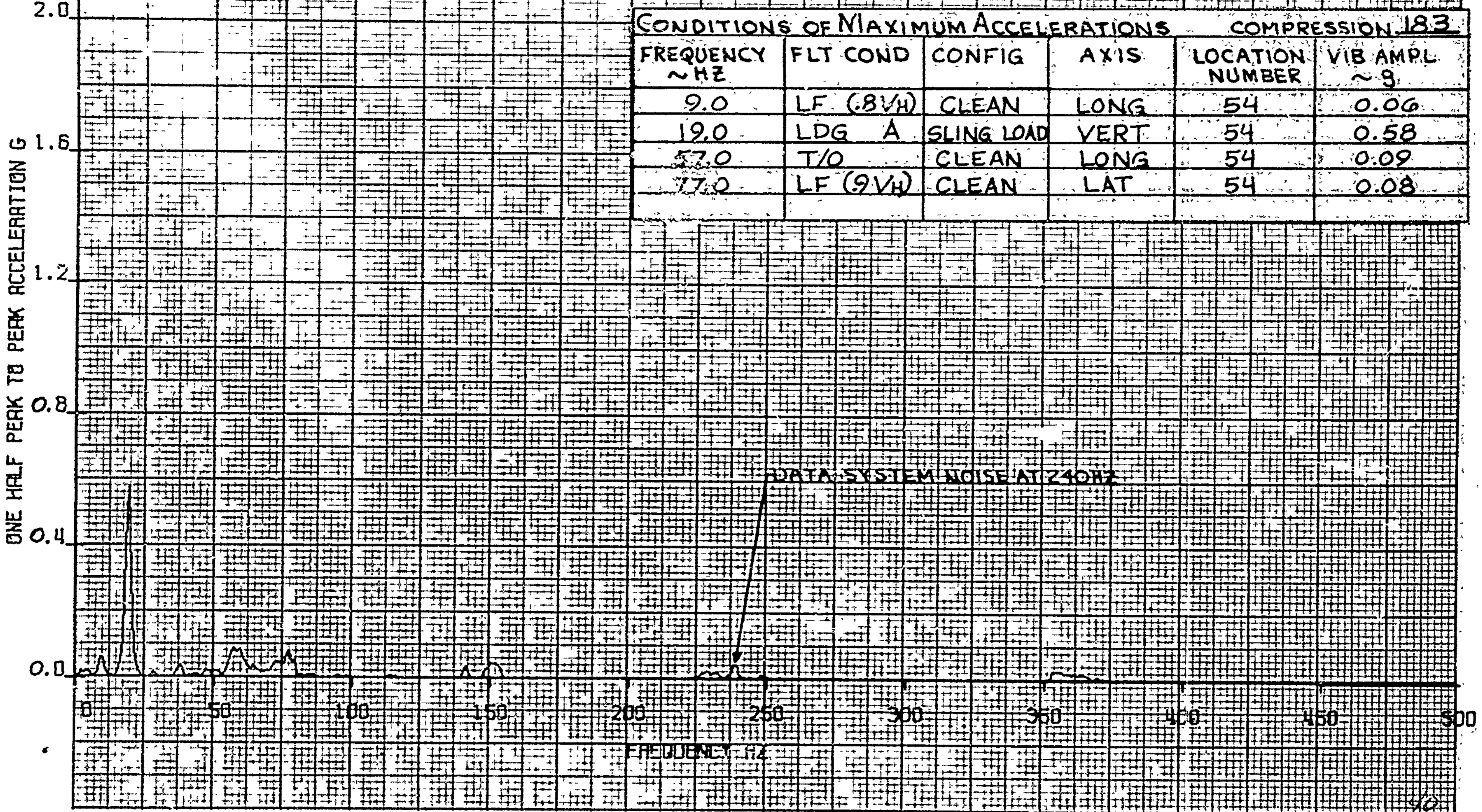
CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA=MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS AFCS SERVO COMBINED AXIS VIB PLOT 183

SENSOR LOC 54 COMPRESSION PASS NO 2

CONDITIONS OF MAXIMUM ACCELERATIONS				COMPRESSION 183	
FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
9.0	LF (.8VH)	CLEAN	LONG	54	0.06
19.0	LDG A	SLING LOAD	VERT	54	0.58
57.0	T/O	CLEAN	LONG	54	0.09
77.0	LF (.9VH)	CLEAN	LAT	54	0.08



40

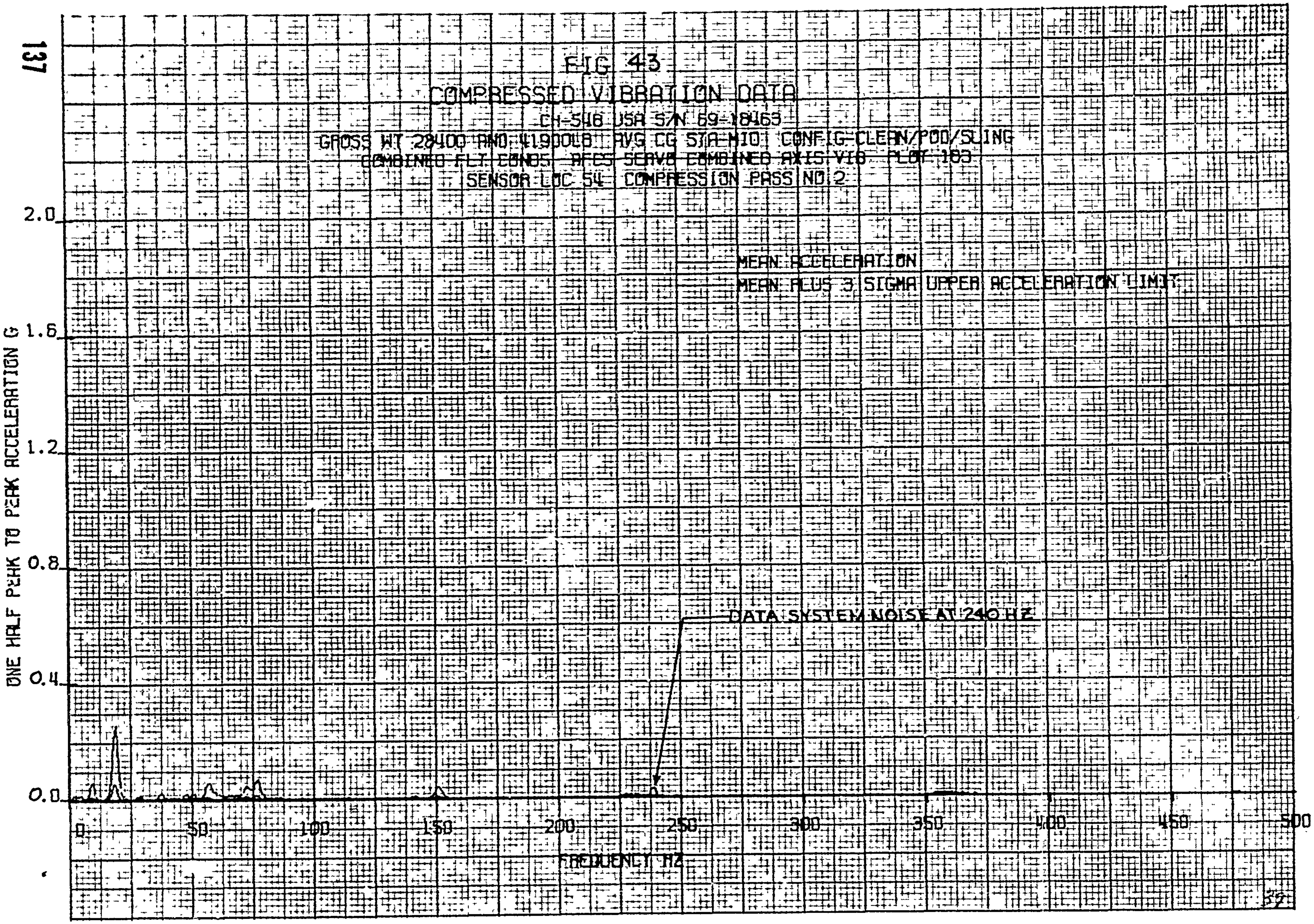


FIG 43
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA MID CONFIG CLEAN/POD/SLING
COMBINED FLT CONDS AFCS SERVO COMBINED AXIS VIB PLOT 103
SENSOR LOC 54 COMPRESSION PASS NO 2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

FIG 44

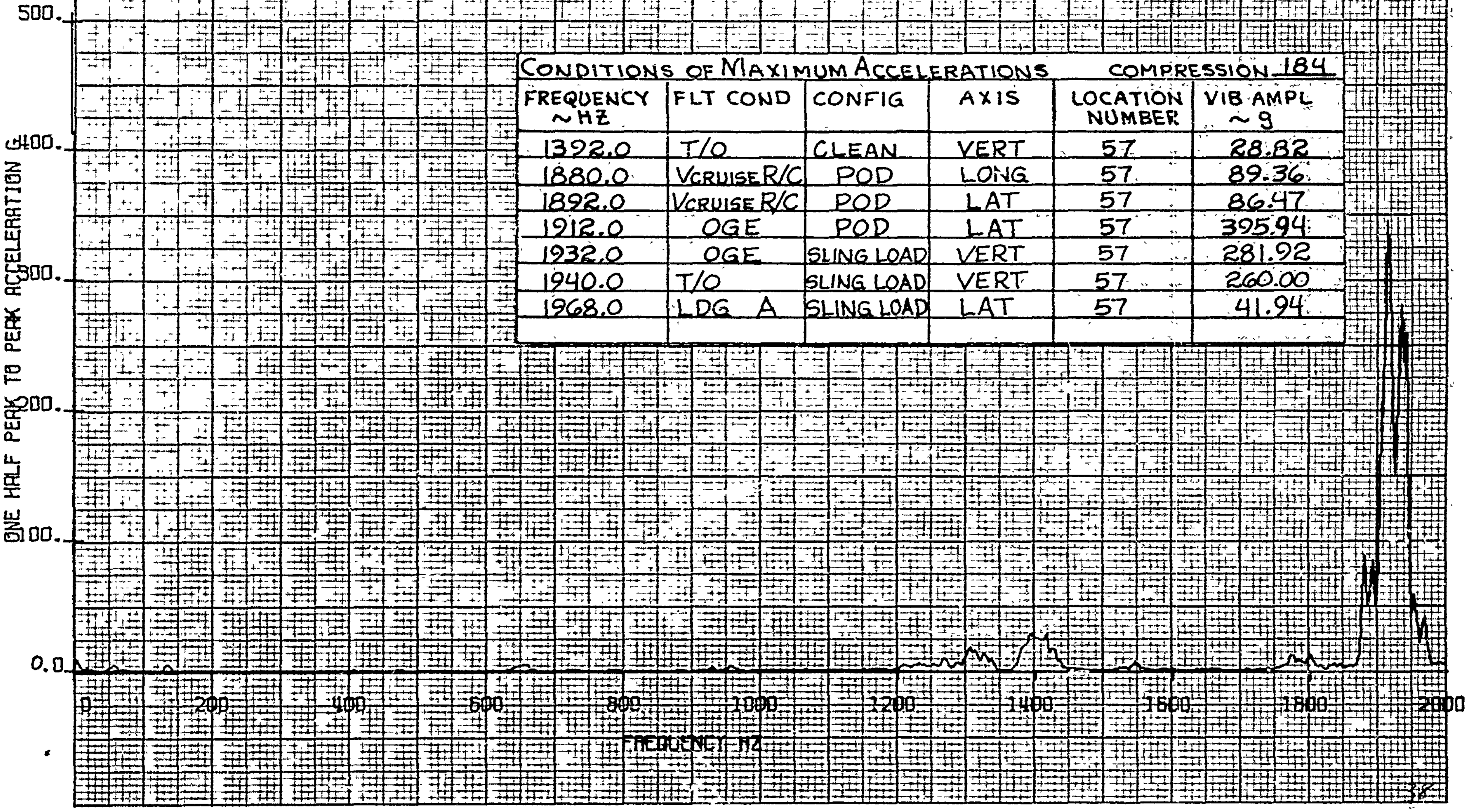
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG CLEAN/POD/SLING

COMBINED FLT CONDS AFP MOUNT AND CLUTCH COMBINED AXIS PLOT 184

SENSOR LOC 57,58 COMPRESSION PASS NO.2



CONDITIONS OF MAXIMUM ACCELERATIONS — COMPRESSION 184

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
1392.0	T/O	CLEAN	VERT	57	28.82
1880.0	VCRUISE R/C	POD	LONG	57	89.36
1892.0	VCRUISE R/C	POD	LAT	57	86.47
1912.0	OGE	POD	LAT	57	395.94
1932.0	OGE	SLING LOAD	VERT	57	281.92
1940.0	T/O	SLING LOAD	VERT	57	260.00
1968.0	LDG A	SLING LOAD	LAT	57	41.94

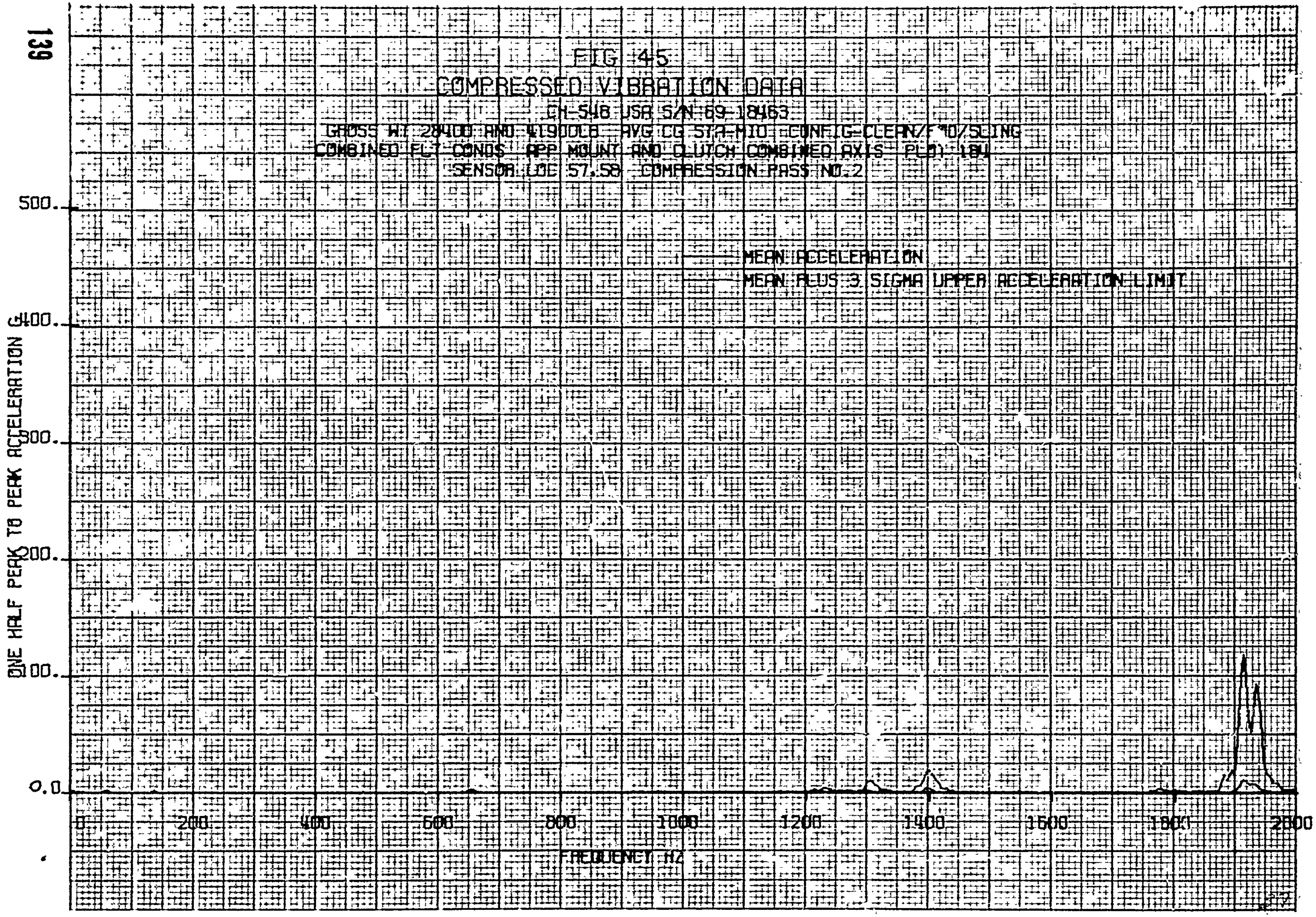


FIG 45
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/F'D/SLING
COMBINED FLT CONDS APP MOUNT AND CLUTCH COMBINED AXIS PLOT 18V
SENSOR LOC 57.58 COMPRESSION PASS NO.2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
500.
400.
300.
200.
100.
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

FIG 46

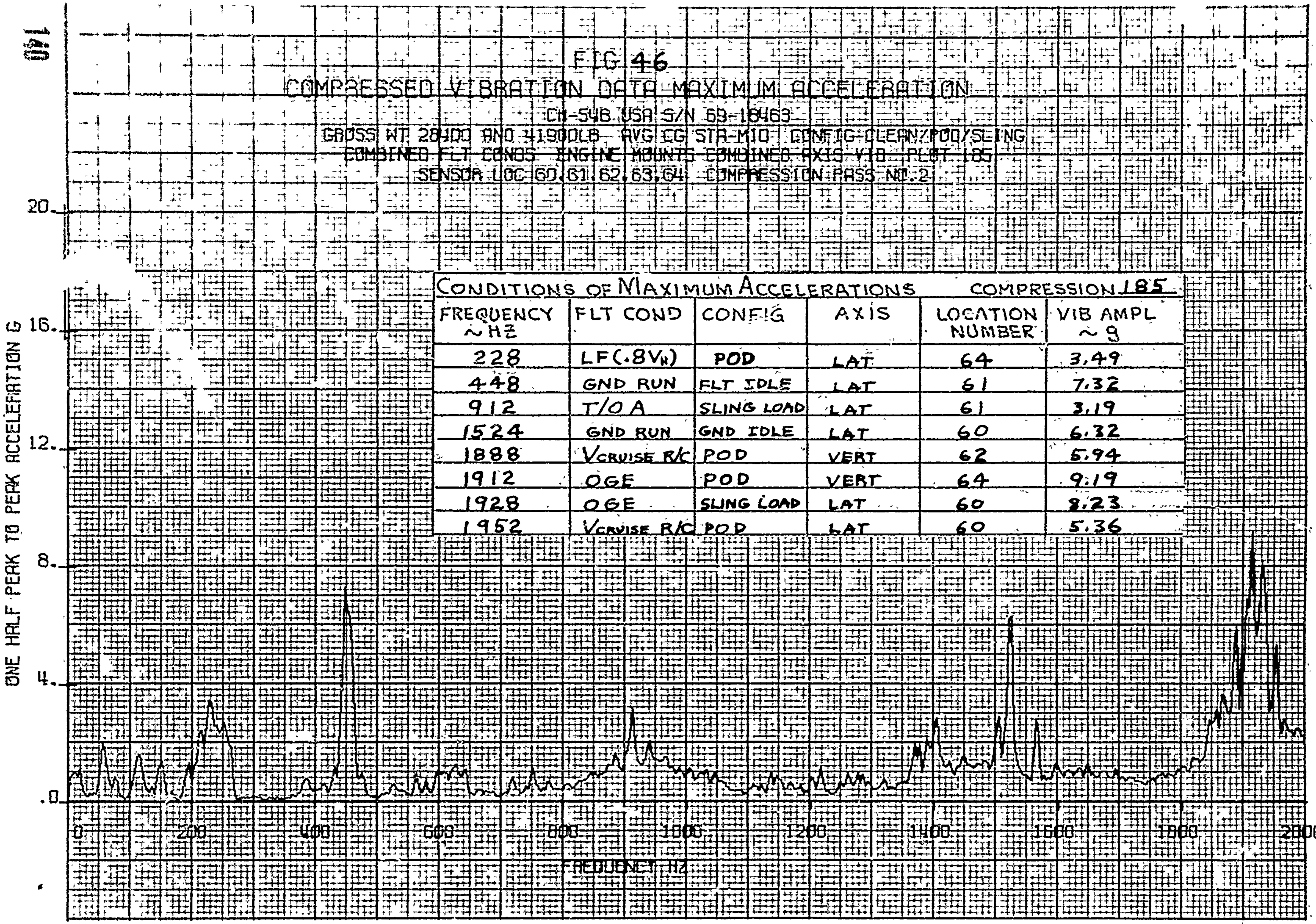
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS ENGINE MOUNTS COMBINED AXIS VIB PLOT 185

SENSOR LOC 60,61,62,63,64 COMPRESSION PASS NO.2



CONDITIONS OF MAXIMUM ACCELERATIONS COMPRESSION 185

FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
228	LF(.8V_H)	POD	LAT	64	3.49
448	GND RUN	FLT IDLE	LAT	61	7.32
912	T/O A	SLING LOAD	LAT	61	3.19
1524	GND RUN	GND IDLE	LAT	60	6.32
1888	V_{CRUISE} R/C	POD	VERT	62	5.94
1912	OGE	POD	VERT	64	9.19
1928	OGE	SLING LOAD	LAT	60	8.23
1952	V_{CRUISE} R/C	POD	LAT	60	5.36

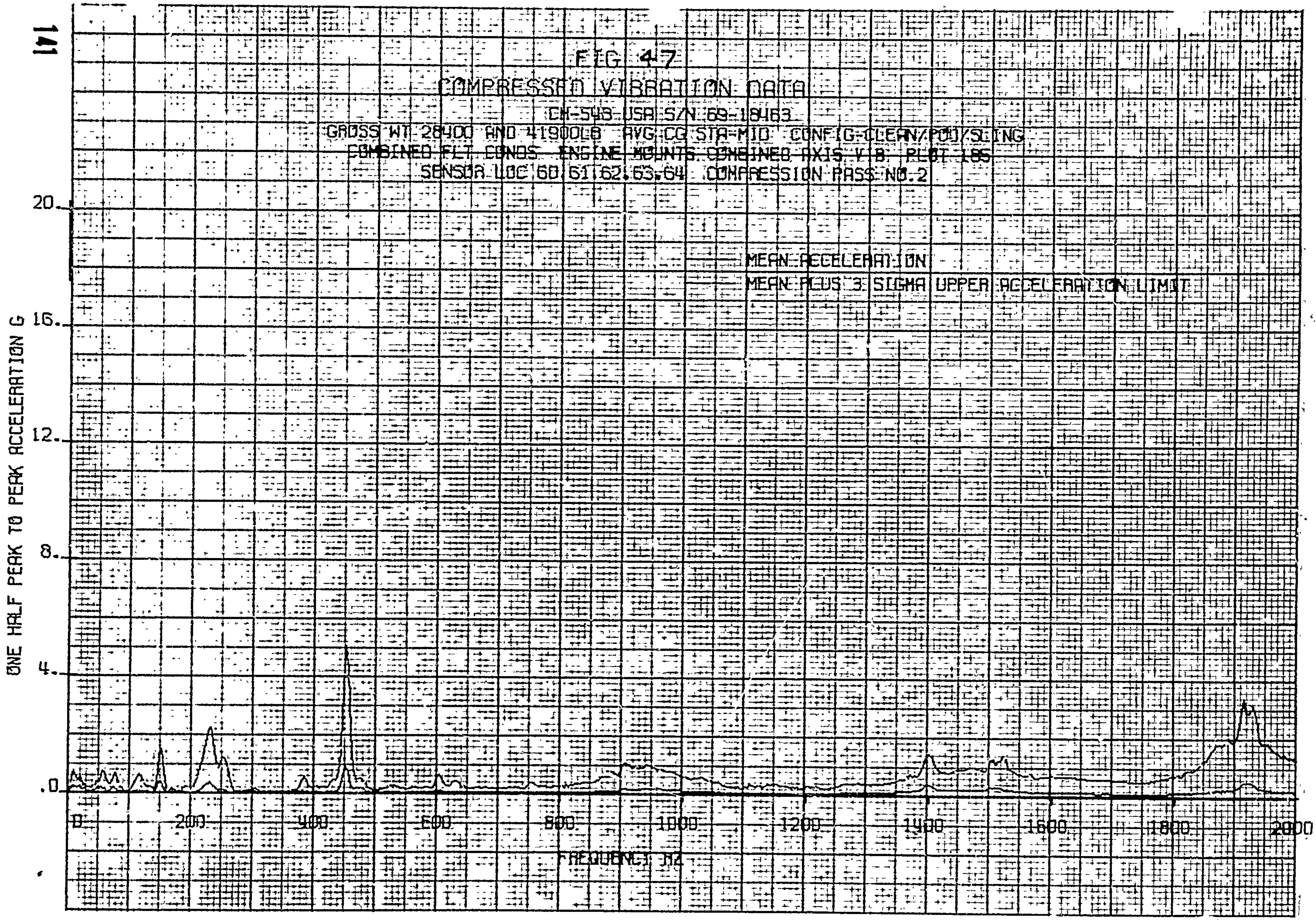


FIG 47
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
COMBINED FLT CONDS ENGINE MOUNTS COMBINED AXIS V B PLOT 185
SENSOR LOC 60 61 62 63 64 COMPRESSION PASS NO.2
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
20.
16.
12.
8.
4.
.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

FIG 48

COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

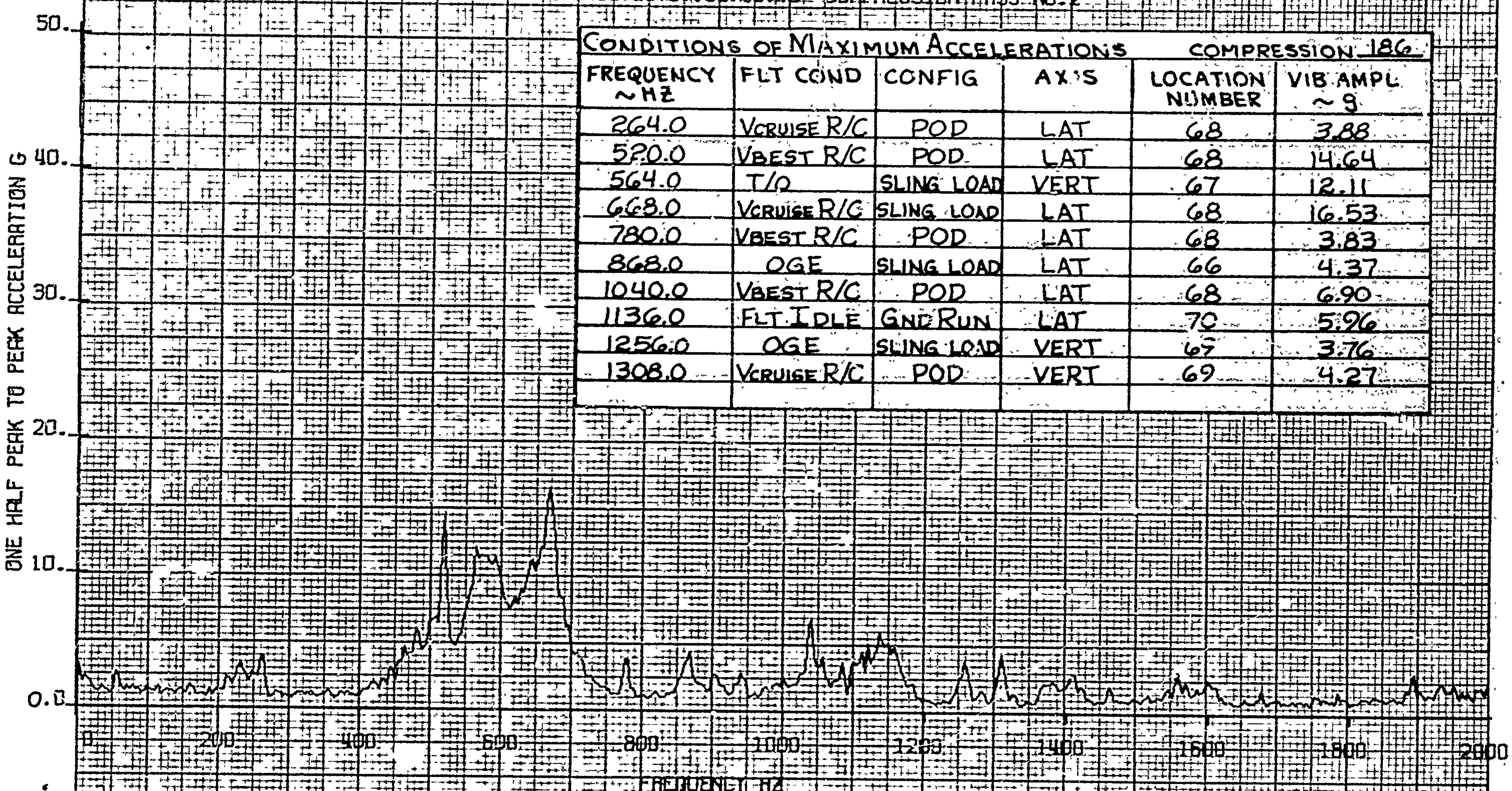
CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG CLEAN/POD/SLING

COMBINED FLT CONDS ENGINE COMBINED AXIS VIB PLOT 186

SENSOR LOC 65.66.67.68.69.70 COMPRESSION PASS NO. 2

CONDITIONS OF MAXIMUM ACCELERATIONS				COMPRESSION 186	
FREQUENCY ~HZ	FLT COND	CONFIG	AXIS	LOCATION NUMBER	VIB AMPL ~g
264.0	VCRUISE R/C	POD	LAT	68	3.88
520.0	VBEST R/C	POD	LAT	68	14.64
564.0	T/O	SLING LOAD	VERT	67	12.11
668.0	VCRUISE R/C	SLING LOAD	LAT	68	16.53
780.0	VBEST R/C	POD	LAT	68	3.83
868.0	OGE	SLING LOAD	LAT	66	4.37
1040.0	VBEST R/C	POD	LAT	68	6.90
1136.0	FLT IDLE	GND RUN	LAT	70	5.96
1256.0	OGE	SLING LOAD	VERT	67	3.76
1308.0	VCRUISE R/C	POD	VERT	69	4.27



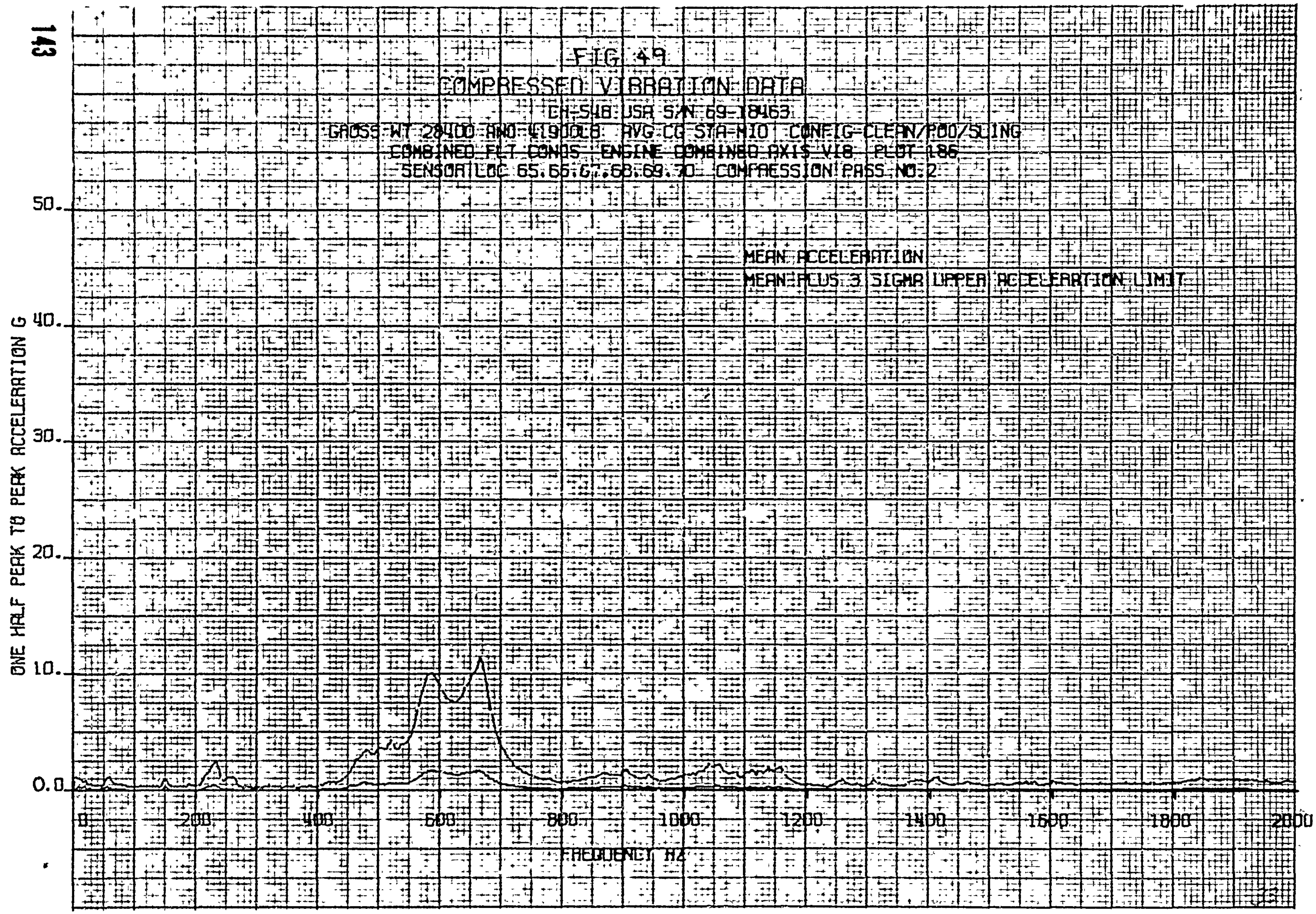


FIG 49

COMPRESSED VIBRATION DATA

CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

COMBINED FLT CONDS ENGINE COMBINED AXIS V18 PLOT 186

SENSOR LOC 65.66.67.68.69.70 COMPRESSION PASS NO.2

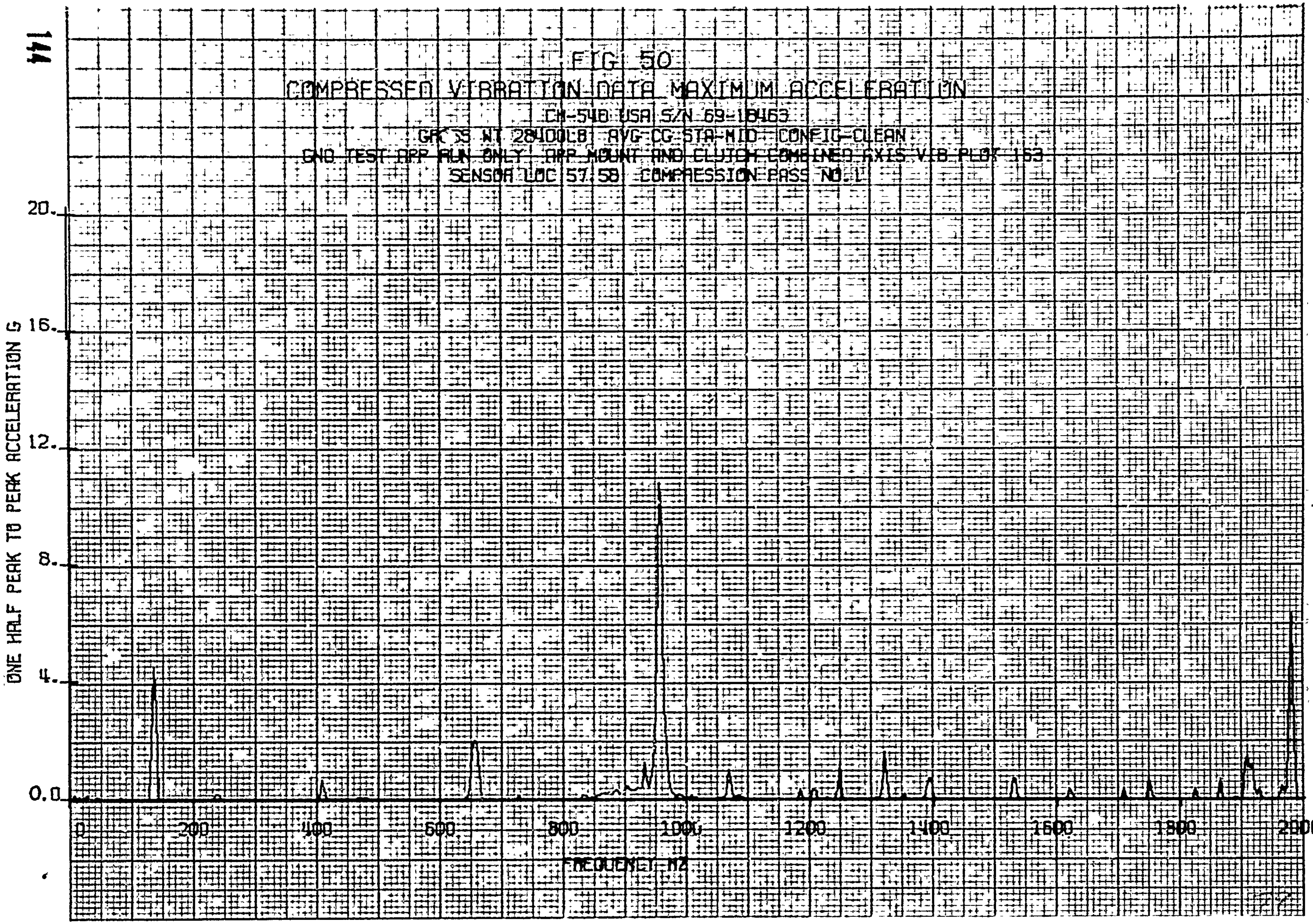
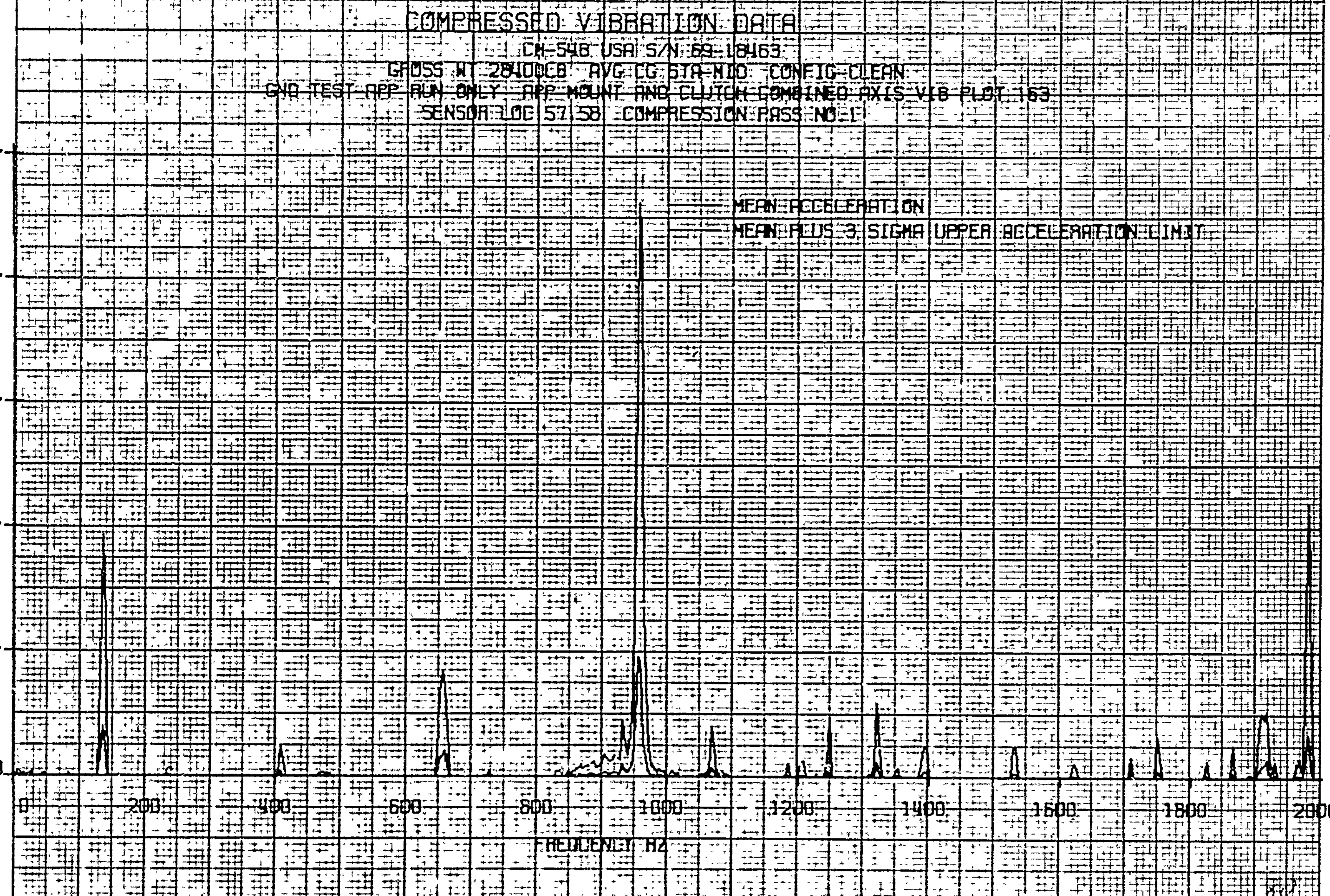
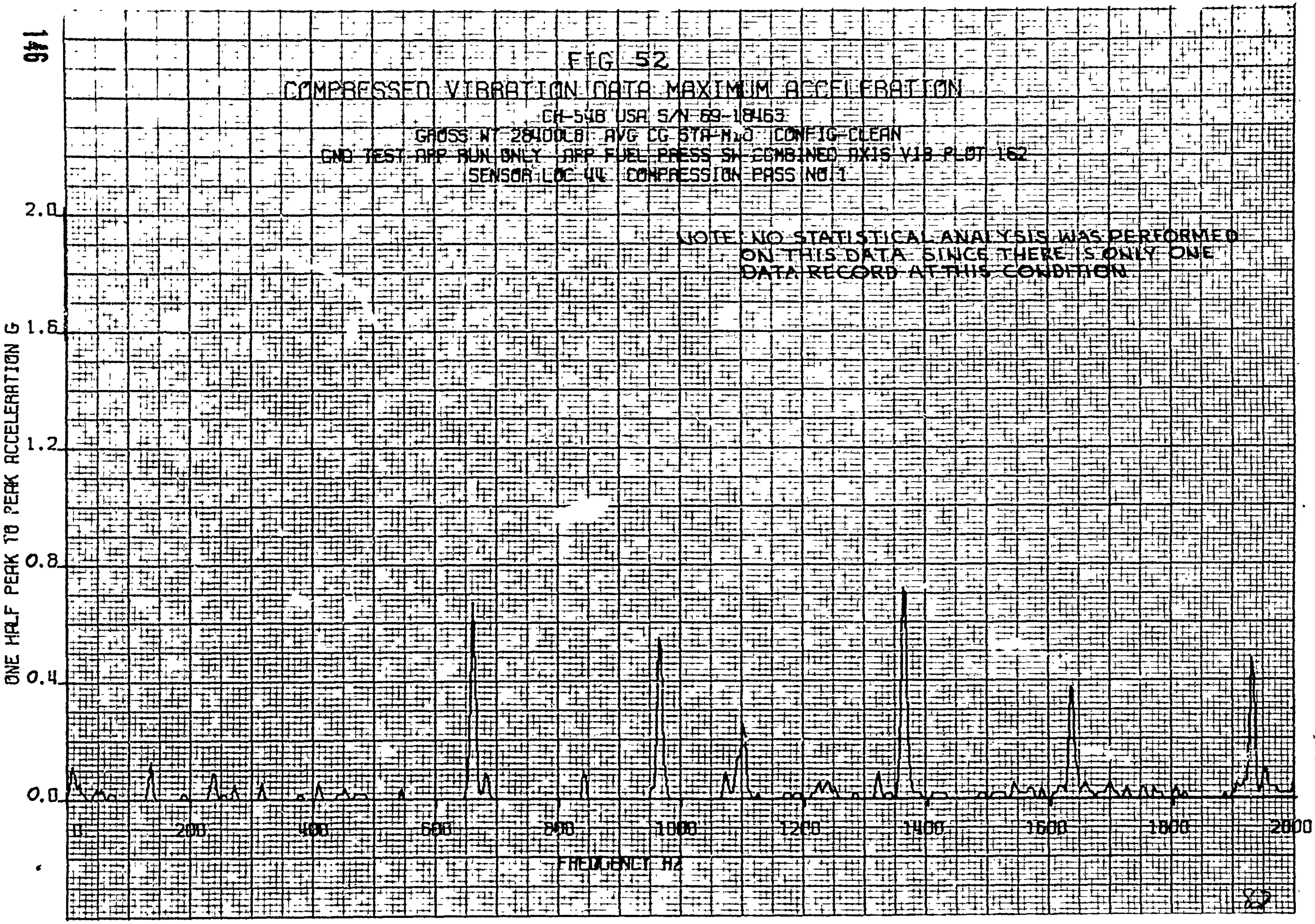


FIG 50
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400LB AVG-CG STA-MID CONFIG-CLEAN
GND TEST APP RUN ONLY APP MOUNT AND CLUTCH COMBINED AXIS VIB PLOT 153
SENSOR LOC 57.58 COMPRESSION PASS NO.1

FIG 51


COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400CB AVG CG STA-MID CONFIG-CLEAN
GND TEST-APP RUN ONLY APP MOUNT AND CLUTCH COMBINED AXIS VIB PLOT 163
SENSOR LOC 57 58 COMPRESSION PASS NO 1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
20.
16.
12.
8.
4.
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ


146
FIG 52
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400LB AVG CG STA M.0 CONFIG-CLEAN
GND TEST APP RUN ONLY APP FUEL PRESS SW COMBINED AXIS VIB PLOT 162
SENSOR LOC 44 COMPRESSION PASS NO 1
NOTE: NO STATISTICAL ANALYSIS WAS PERFORMED ON THIS DATA SINCE THERE IS ONLY ONE DATA RECORD AT THIS CONDITION
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

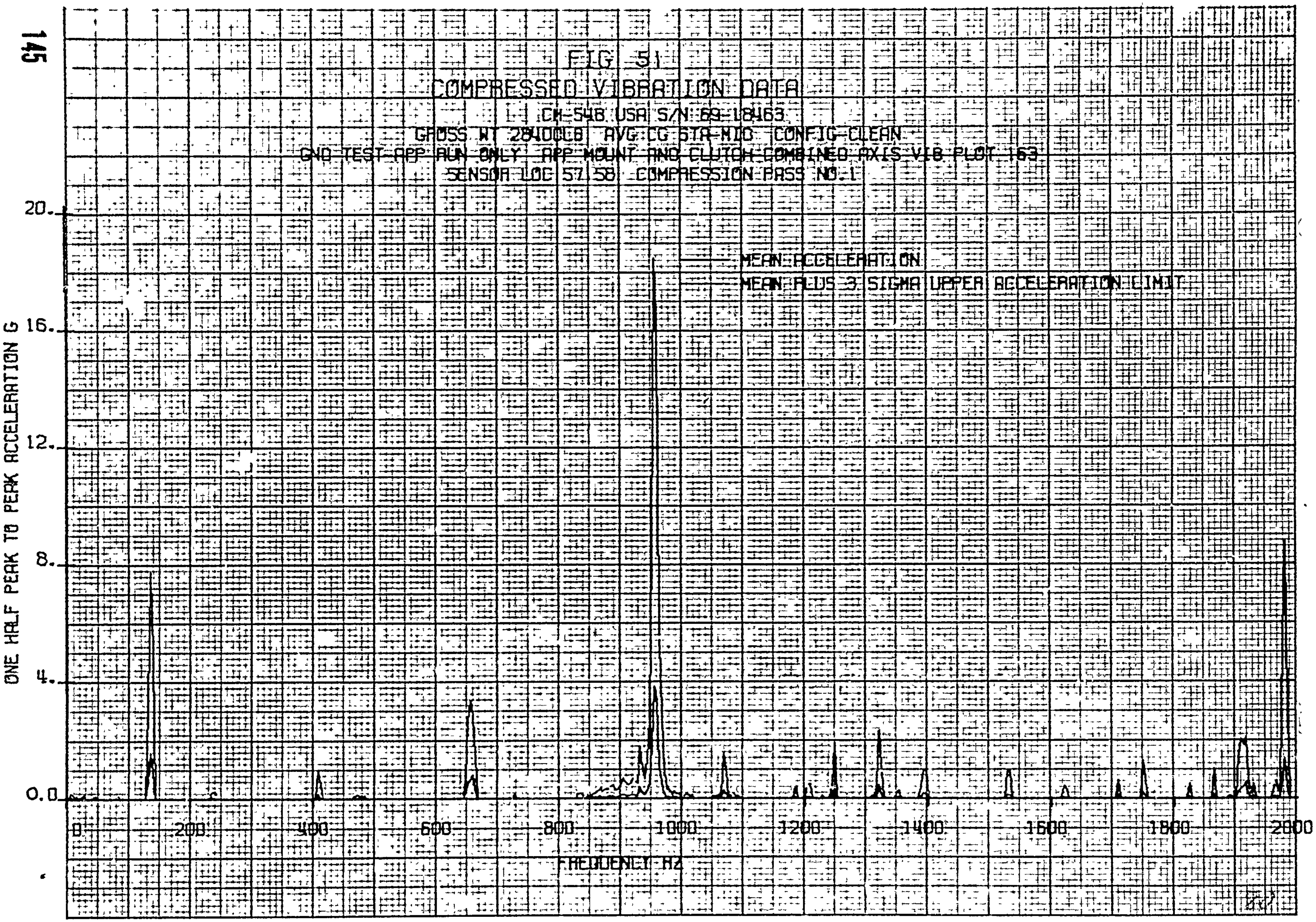
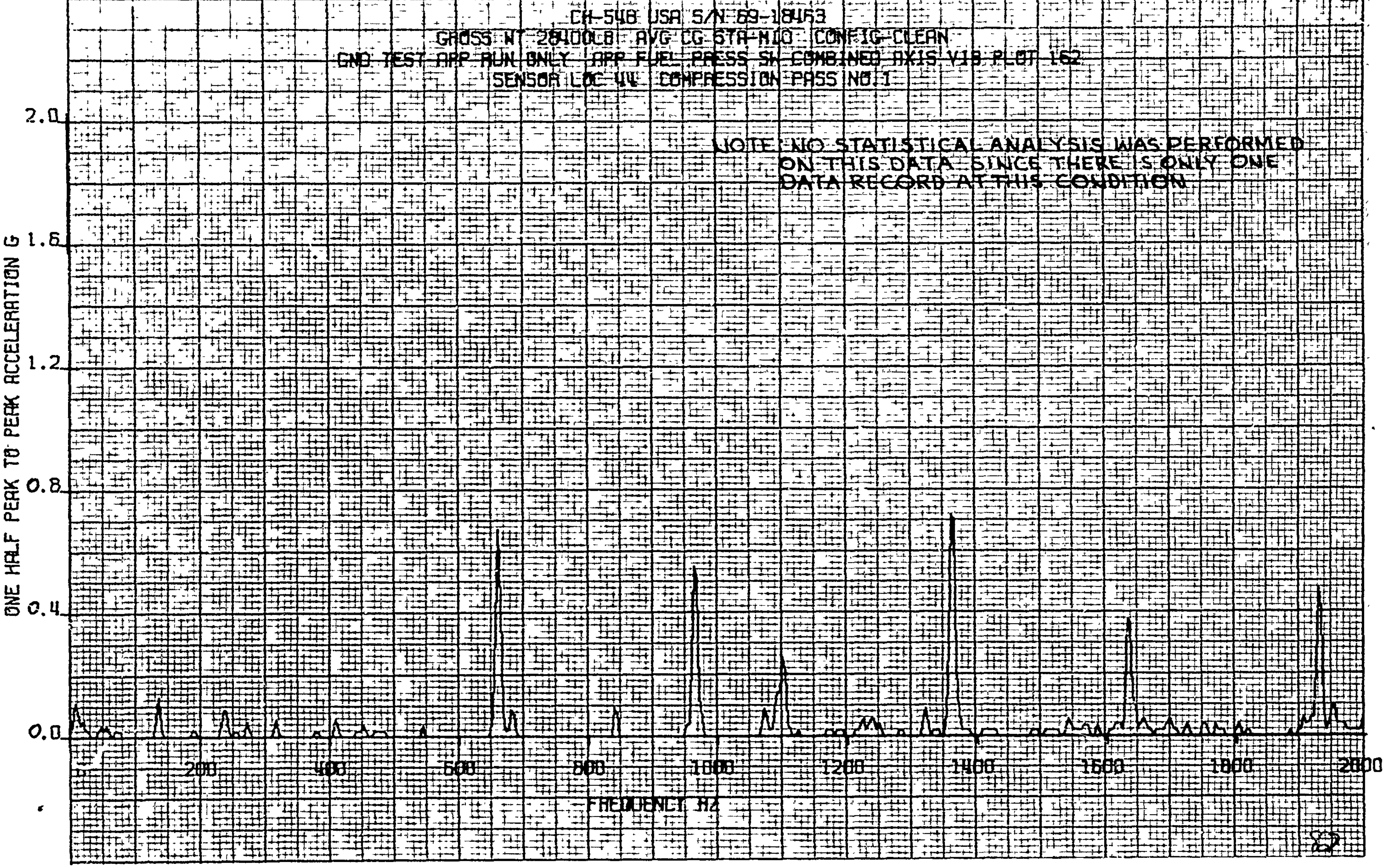


FIG 51
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400LB AVG CG STA-MID CONFIG-CLEAN
GND TEST APP RUN ONLY APP MOUNT AND CLUTCH COMBINED AXIS VIB PLOT 163
SENSOR LOC 57.58 COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
20.
16.
12.
8.
4.
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

FIG 52

COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION



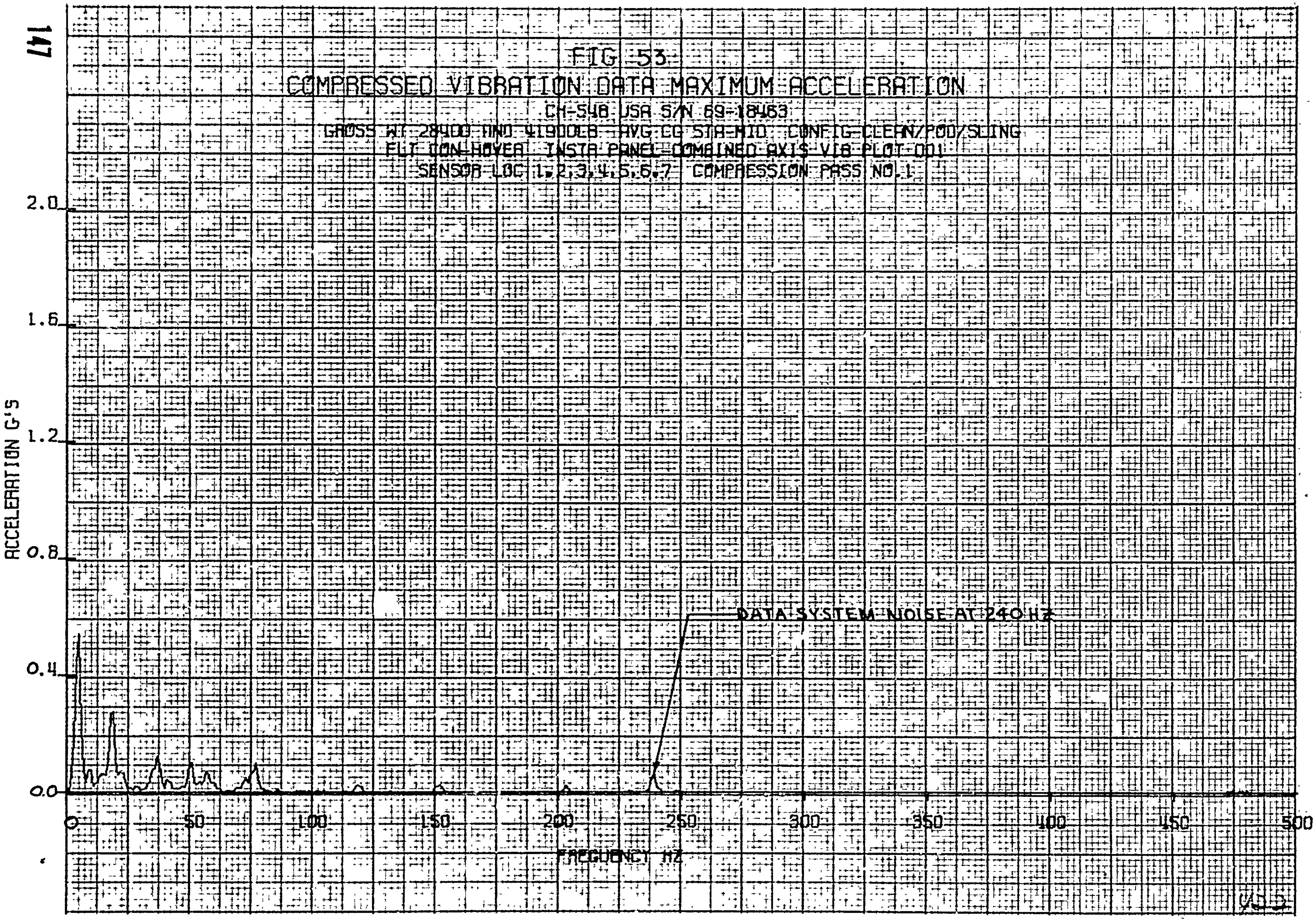


FIG 53
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT CON-HOVER INSTR PANEL COMBINED AXIS VIB PLOT 001
SENSOR LOC 1,2,3,4,5,6,7 COMPRESSION PASS NO.1

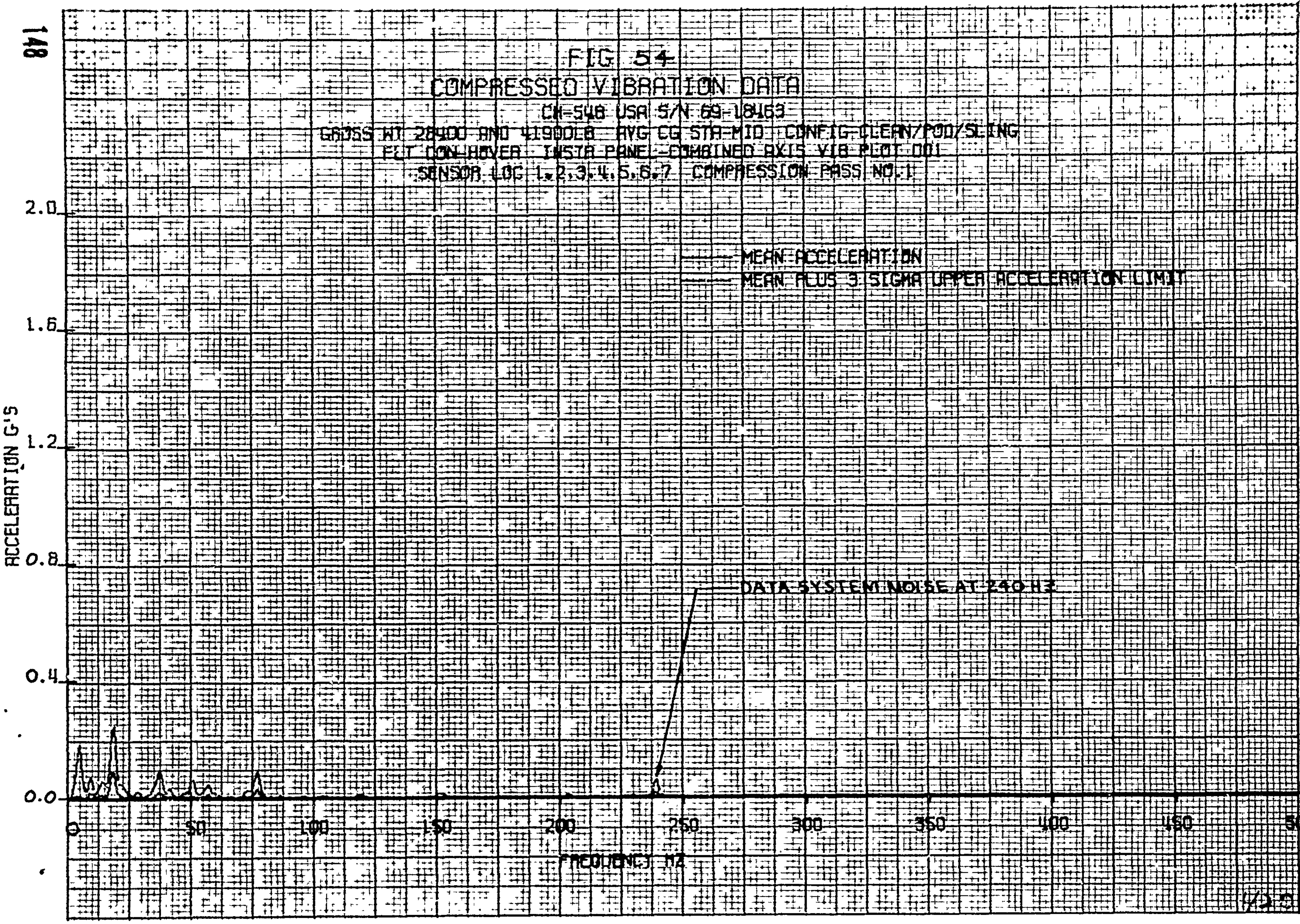


FIG 54
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG CLEAN/POD/SLING
FLT CON HOVER INSTR PANE -COMBINED AXIS VIB PLOT 001
SENSOR LOC 1,2,3,4,5,6,7 COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240 HZ
ACCELERATION G'S
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

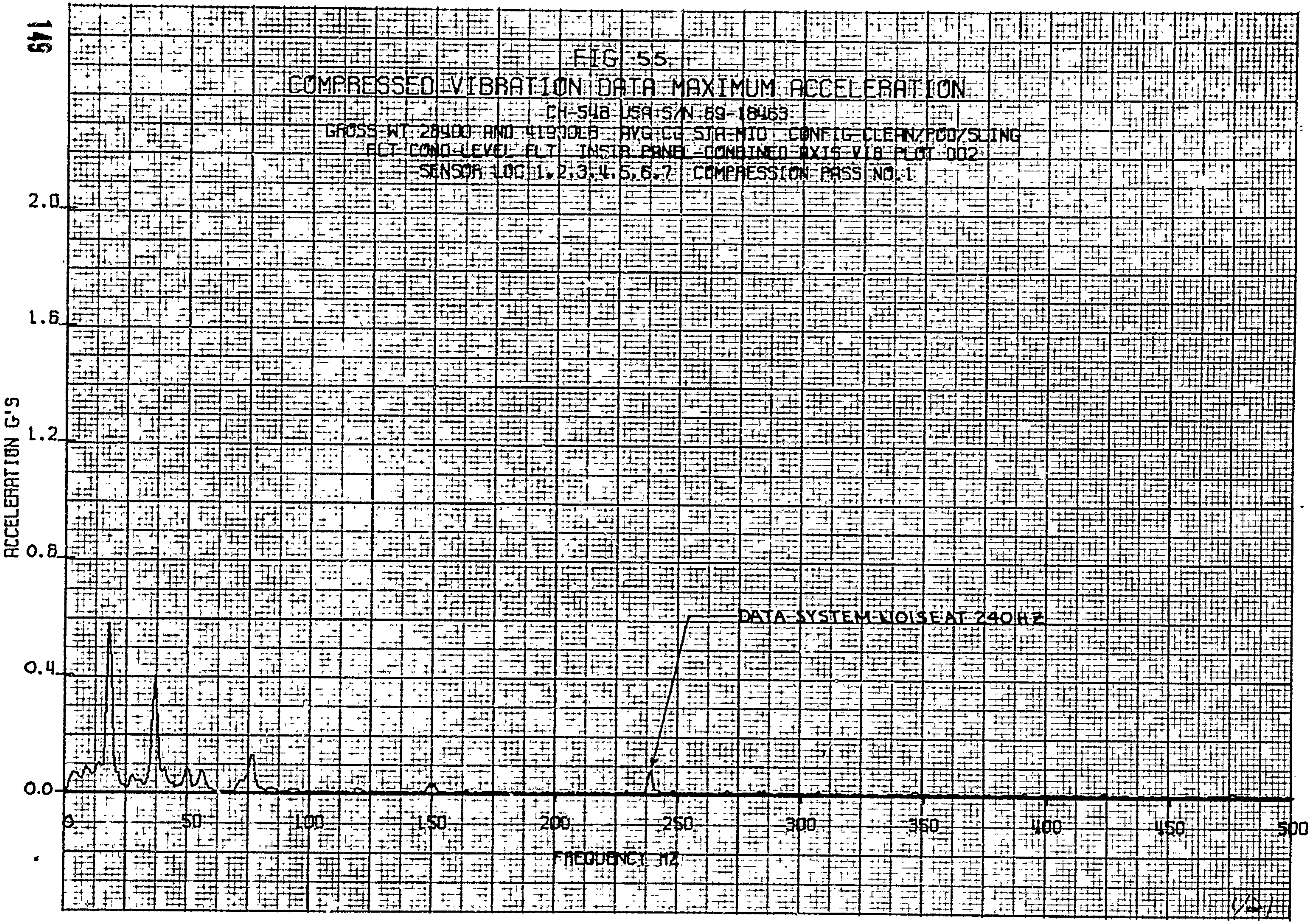


FIG 55.
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28900 AND 41900LB AVG CG STA MID CONFIG CLEAN/POD/SLING
FLT COND LEVEL FLT INSTR PANEL COMBINED AXIS VIB PLOT 002
SENSOR LOC 1,2,3,4,5,6,7 COMPRESSION PASS NO.1

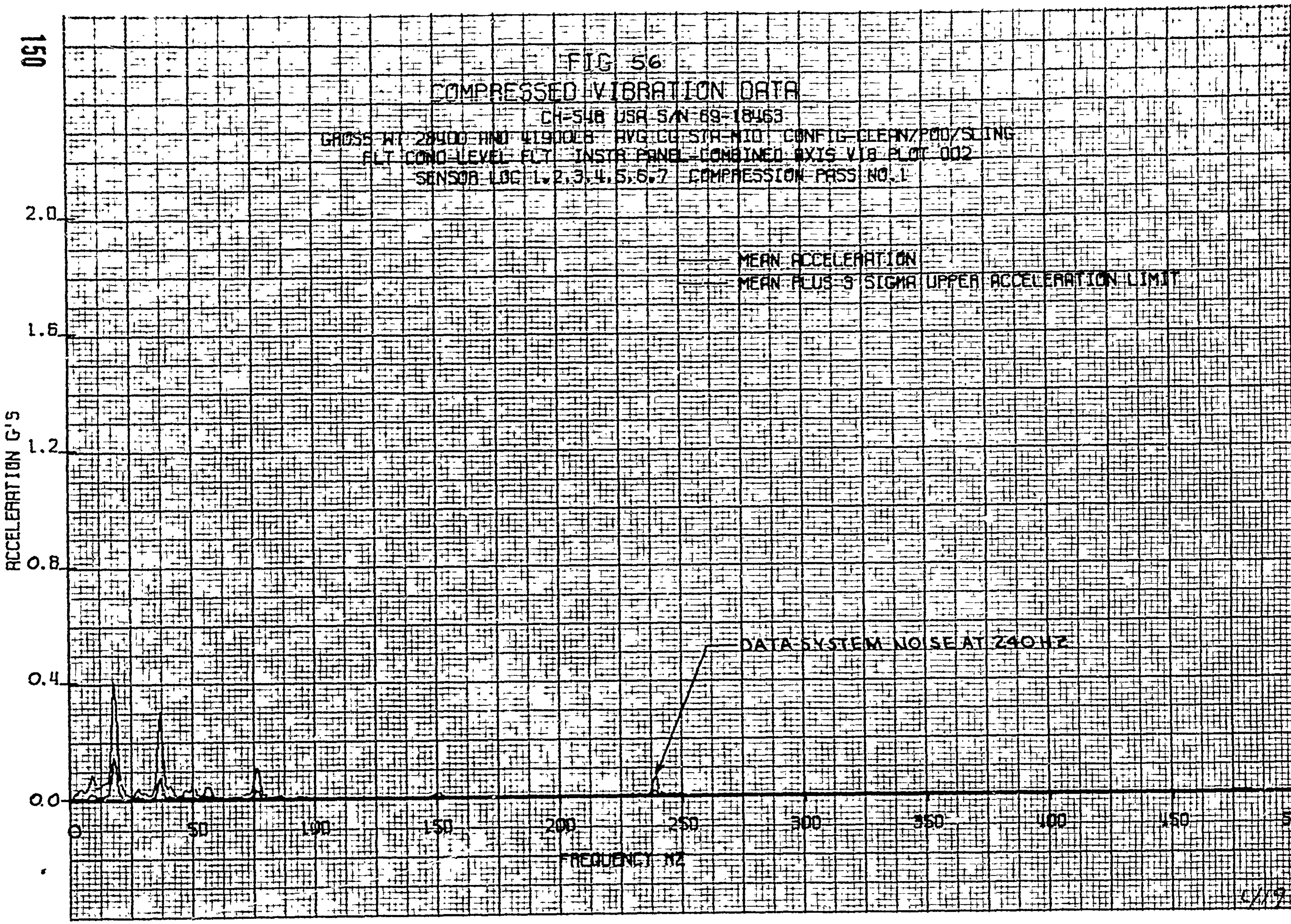


FIG 56
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28900 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-LEVEL FLT INSTR PANEL-COMBINED AXIS V18 PLOT 002
SENSOR LOC 1,2,3,4,5,6,7 COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240 HZ
ACCELERATION G'S
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

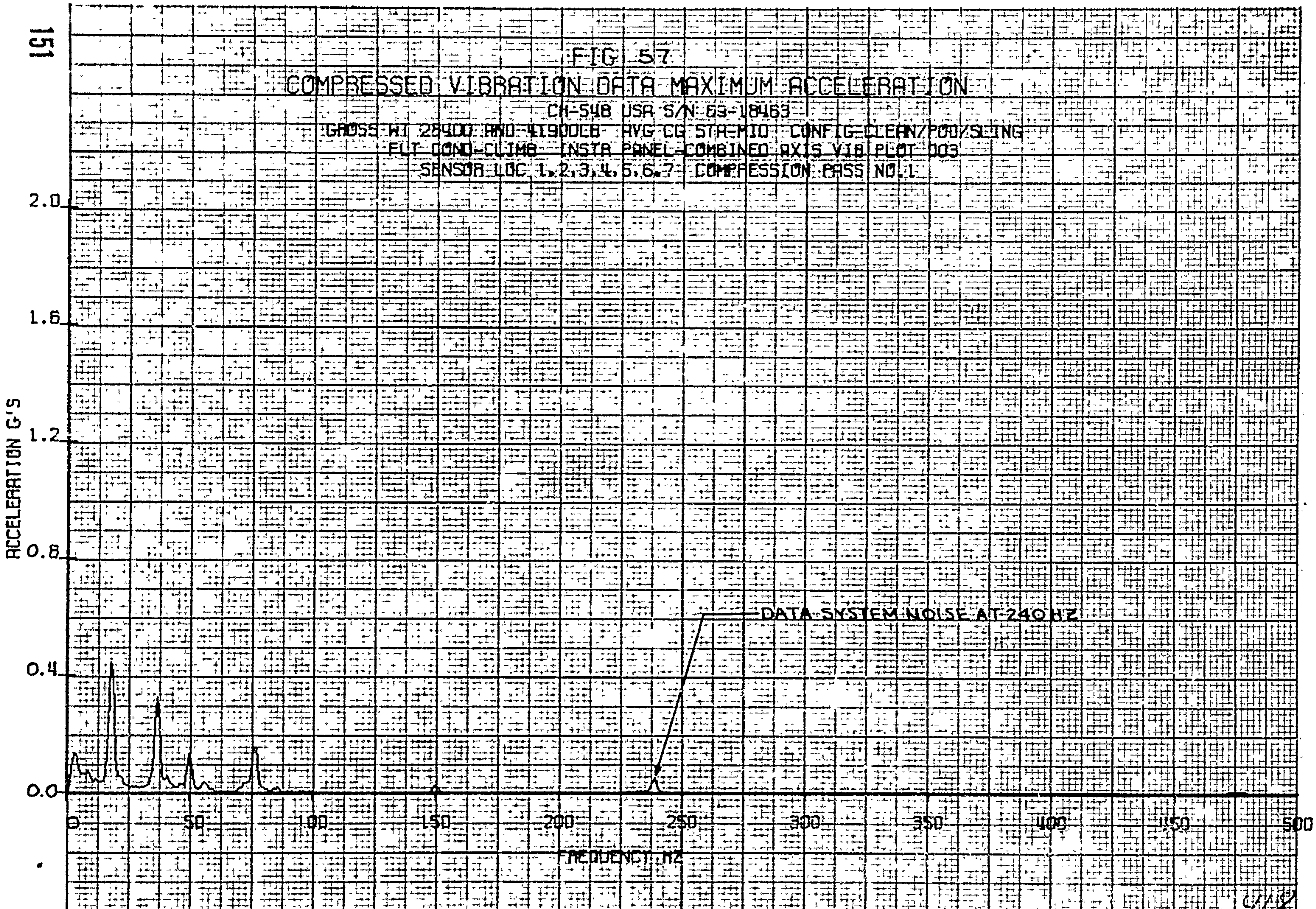


FIG 57
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-CLIMB INSTR PANEL-COMBINED AXIS VIB PLOT 003
SENSOR LOC 1,2,3,4,5,6,7 COMPRESSION PASS NO.1
DATA SYSTEM NOISE AT 240 HZ
ACCELERATION G'S
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

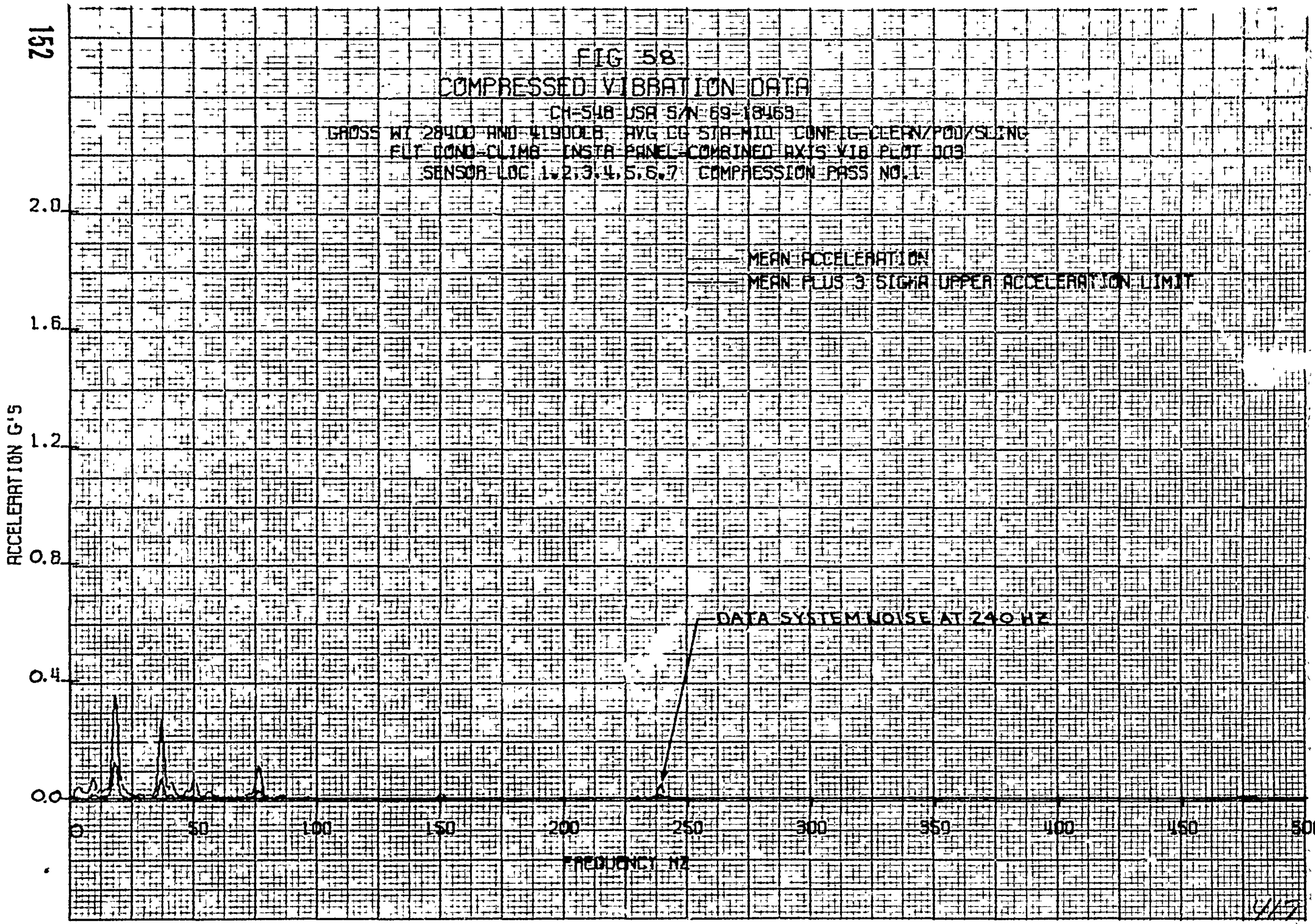


FIG 58
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18469
GROSS WT 28400 AND 41900LB, AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-CLIMB INSTA PANEL-COMBINED AXIS VIB PLOT 003
SENSOR LOC 1,2,3,4,5,6,7 COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240 HZ
ACCELERATION G'S
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

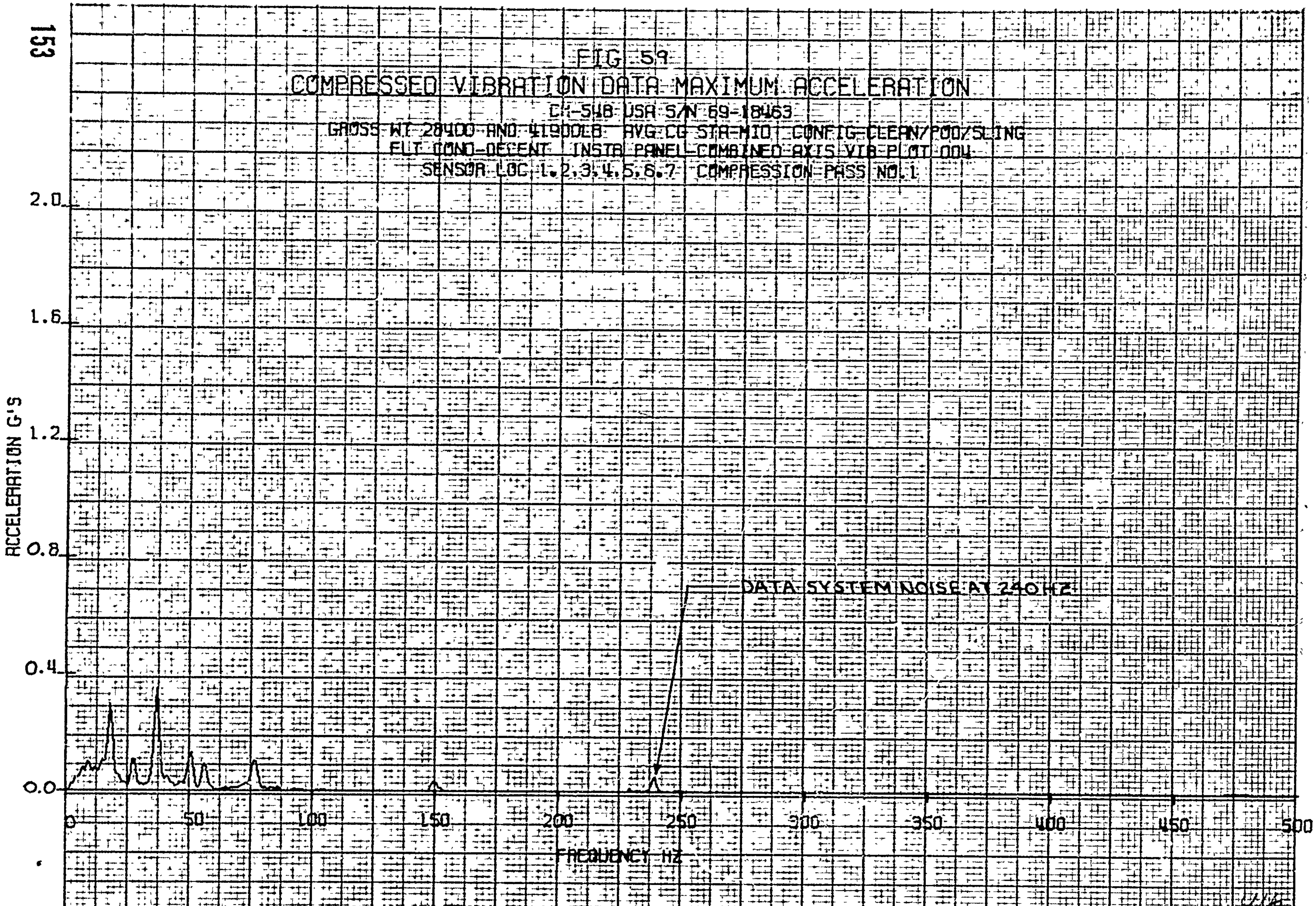
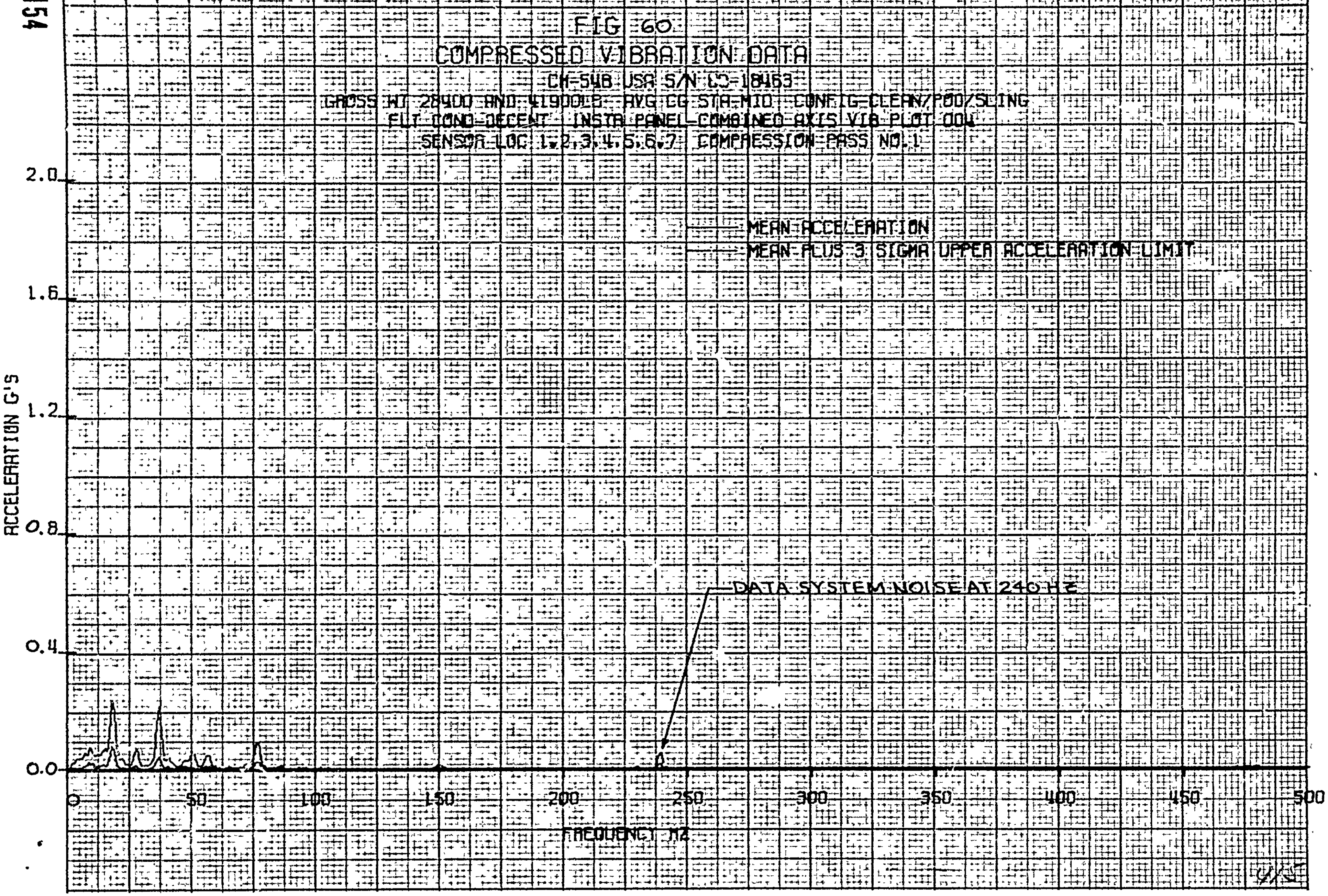


FIG 59
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-DECENT INSTR PANEL-COMBINED AXIS VIB PLOT 004
SENSOR LOC 1,2,3,4,5,6,7 COMPRESSION PASS NO.1
DATA SYSTEM NOISE AT 240 HZ
ACCELERATION G'S
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

FIG 60


COMPRESSED VIBRATION DATA
CH-54B USA S/N 68-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-DECENT INSTR PANEL-COMBINED AXIS VIB PLOT 004
SENSOR LOC 1,2,3,4,5,6,7 COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240 HZ
ACCELERATION G'S
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

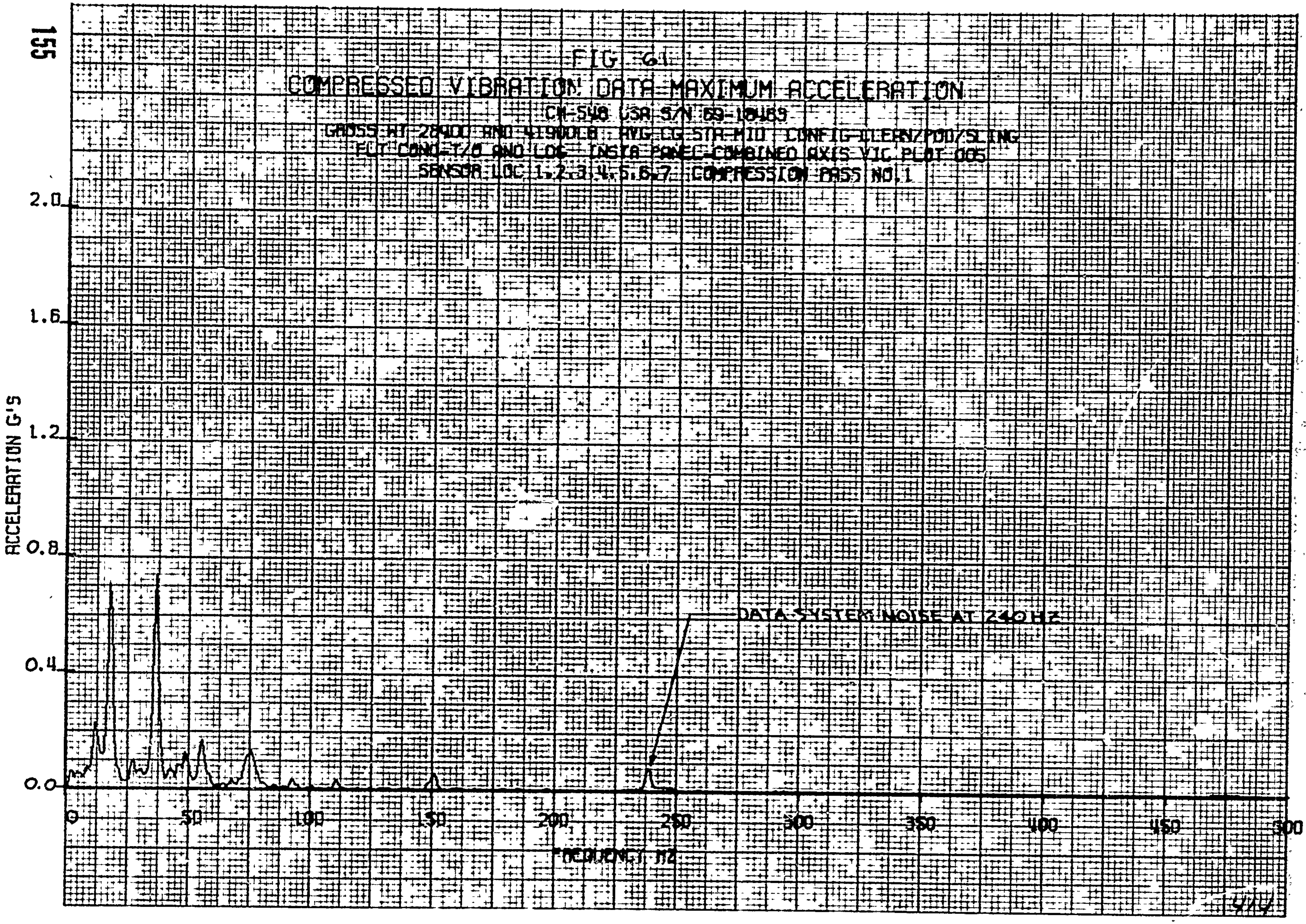


FIG 61
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18483
GROSS WT 28400 AND 41900LB AVG CG STA MID CONFIG-CLEAN/POD/SLING
FLT COND-T/O AND LOG INSTR PANEL-COMBINED AXIS VIC PLOT 005
SENSOR LOC 1,2,3,4,5,6,7 COMPRESSION PASS NO.1
ACCELERATION G'S
2.0
1.6
1.2
0.8
0.4
0.0
DATA SYSTEM NOISE AT 240 HZ
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

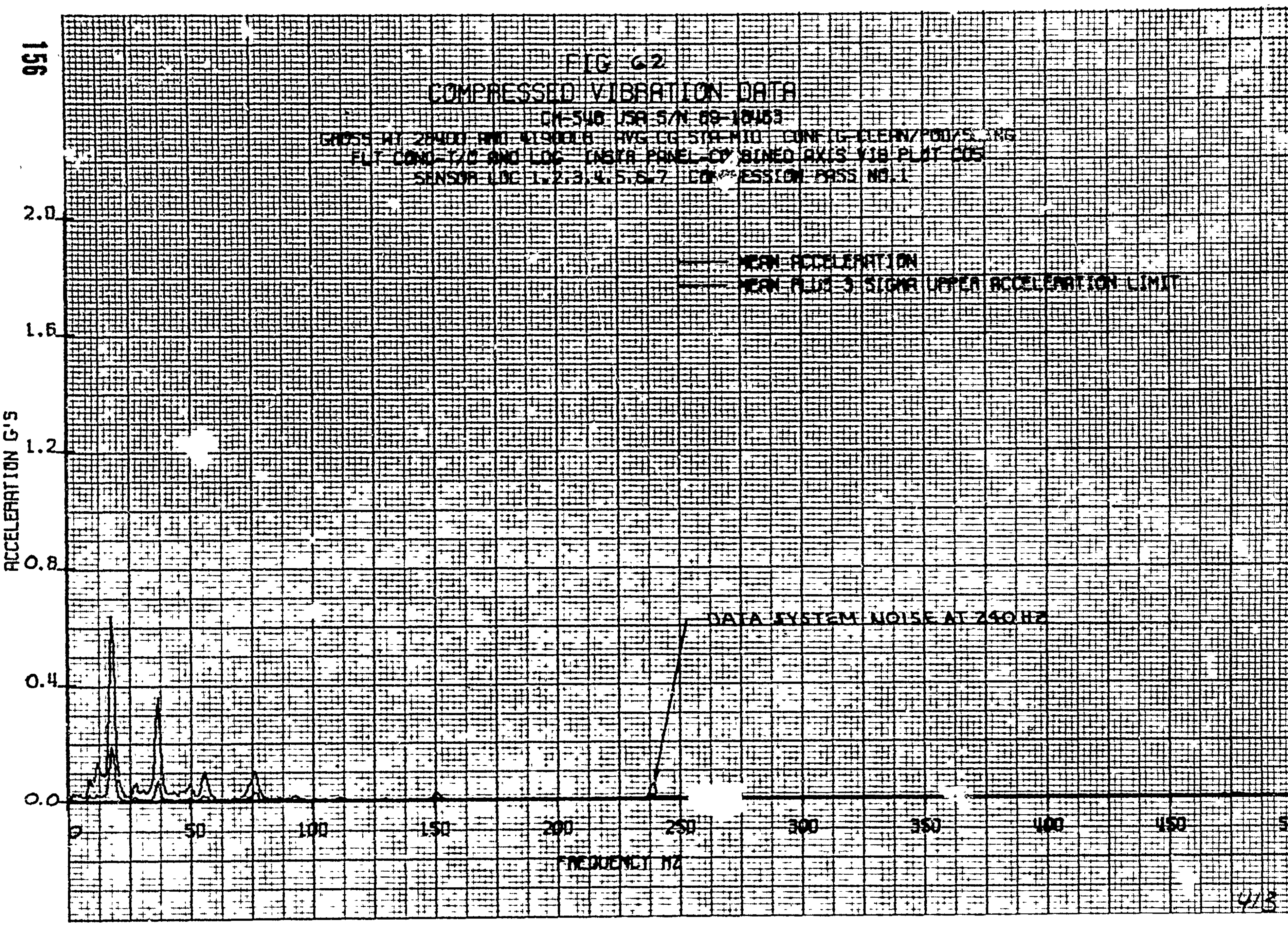


FIG G2
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
SENSOR LOC 1,2,3,4,5,6,7
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240 HZ
ACCELERATION G'S
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

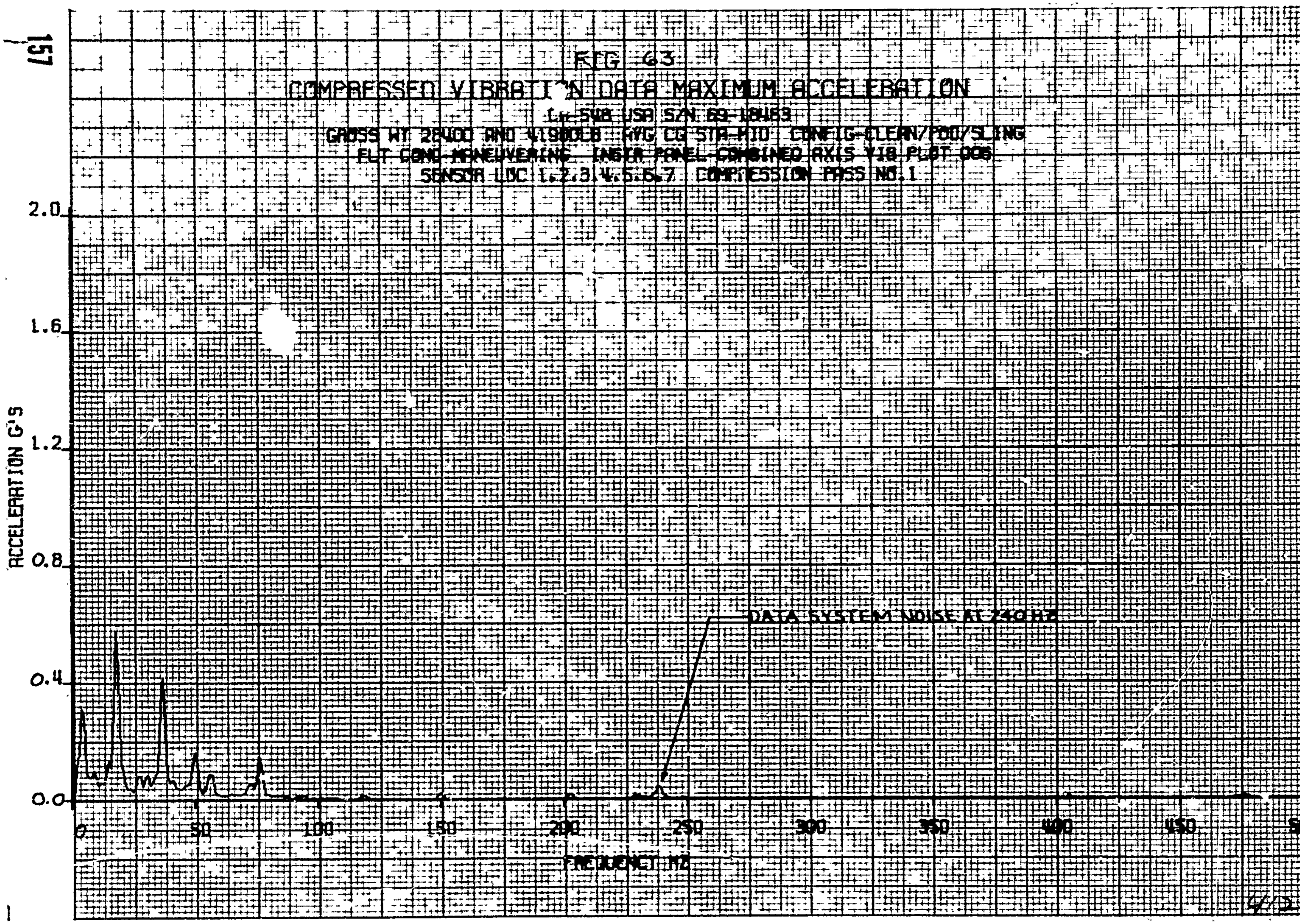


FIG 63
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-MANEUVERING INSTR PANEL COMBINED AXIS VIB PLOT 006
SENSOR LOC 1,2,3,4,5,6,7 COMPRESSION PASS NO.1
ACCELERATION G'S
2.0
1.6
1.2
0.8
0.4
0.0
DATA SYSTEM NOISE AT 240 HZ
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

FIG 64

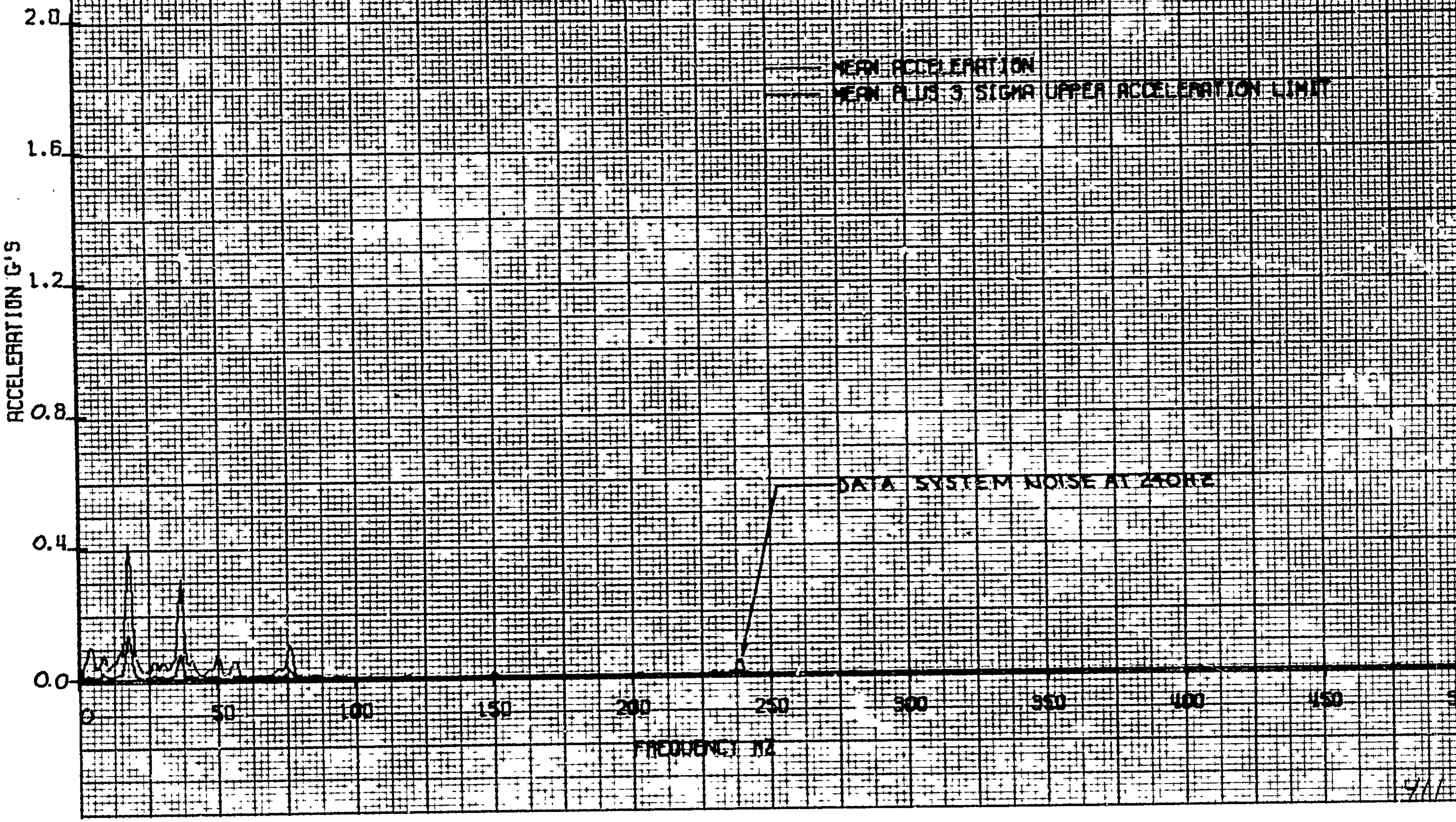
COMPRESSED VIBRATION DATA

CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

FLT COND-MANEUVERING INSTR PANEL-COMBINED AXIS VIB PLOT 006

SENSOR LOC 1,2,3,4,5,6,7 COMPRESSION PASS NO.1



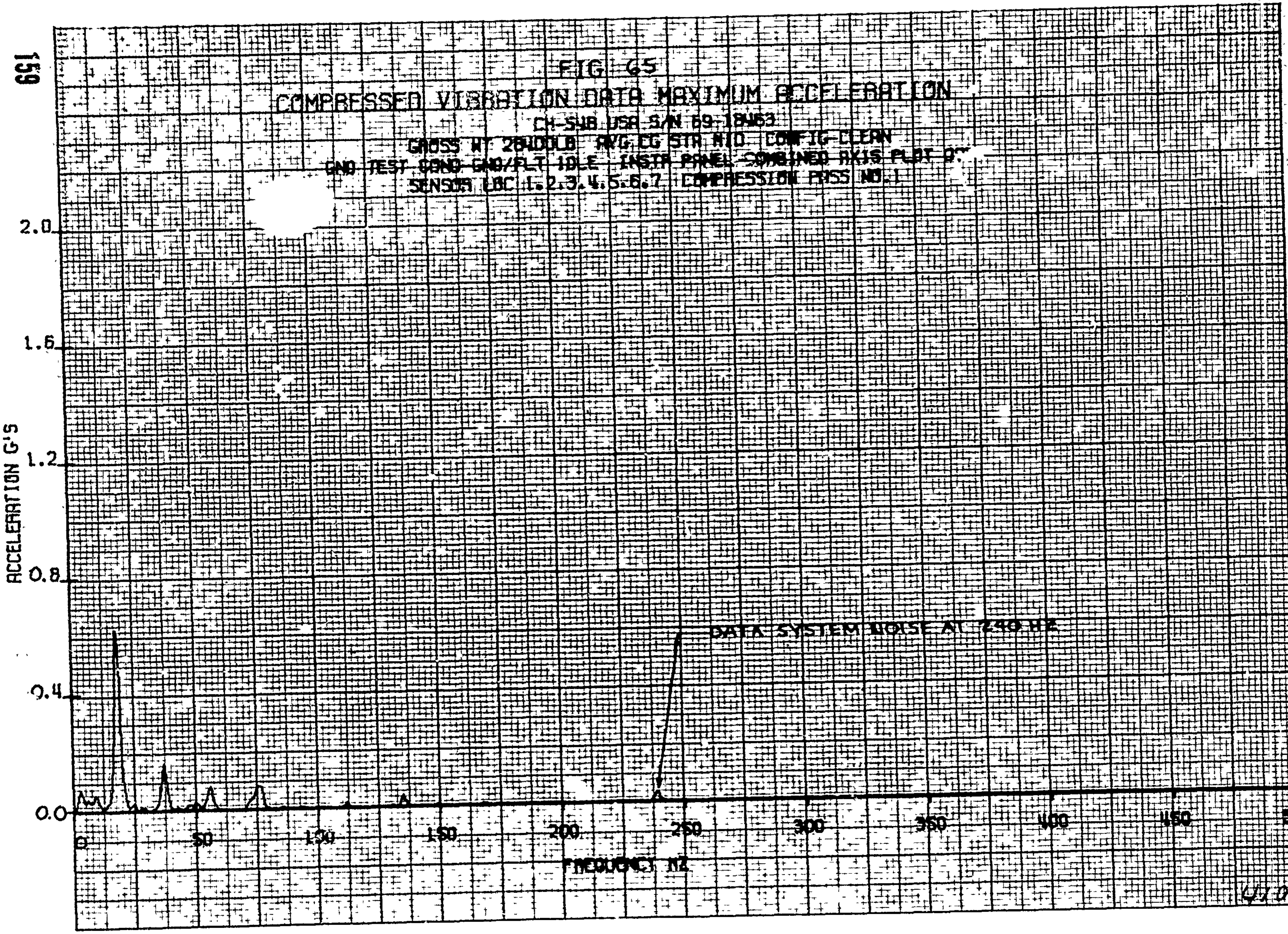


FIG 65
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 20400LB AVG CG STA MID CONFIG-CLEAN
GND TEST COND GND/FLT IDLE INSTR PANEL COMBINED AXIS PLOT
SENSOR LOC 1.2.3.4.5.6.7 COMPRESSION PASS NO.1
DATA SYSTEM NOISE AT 240 HZ
ACCELERATION G'S
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

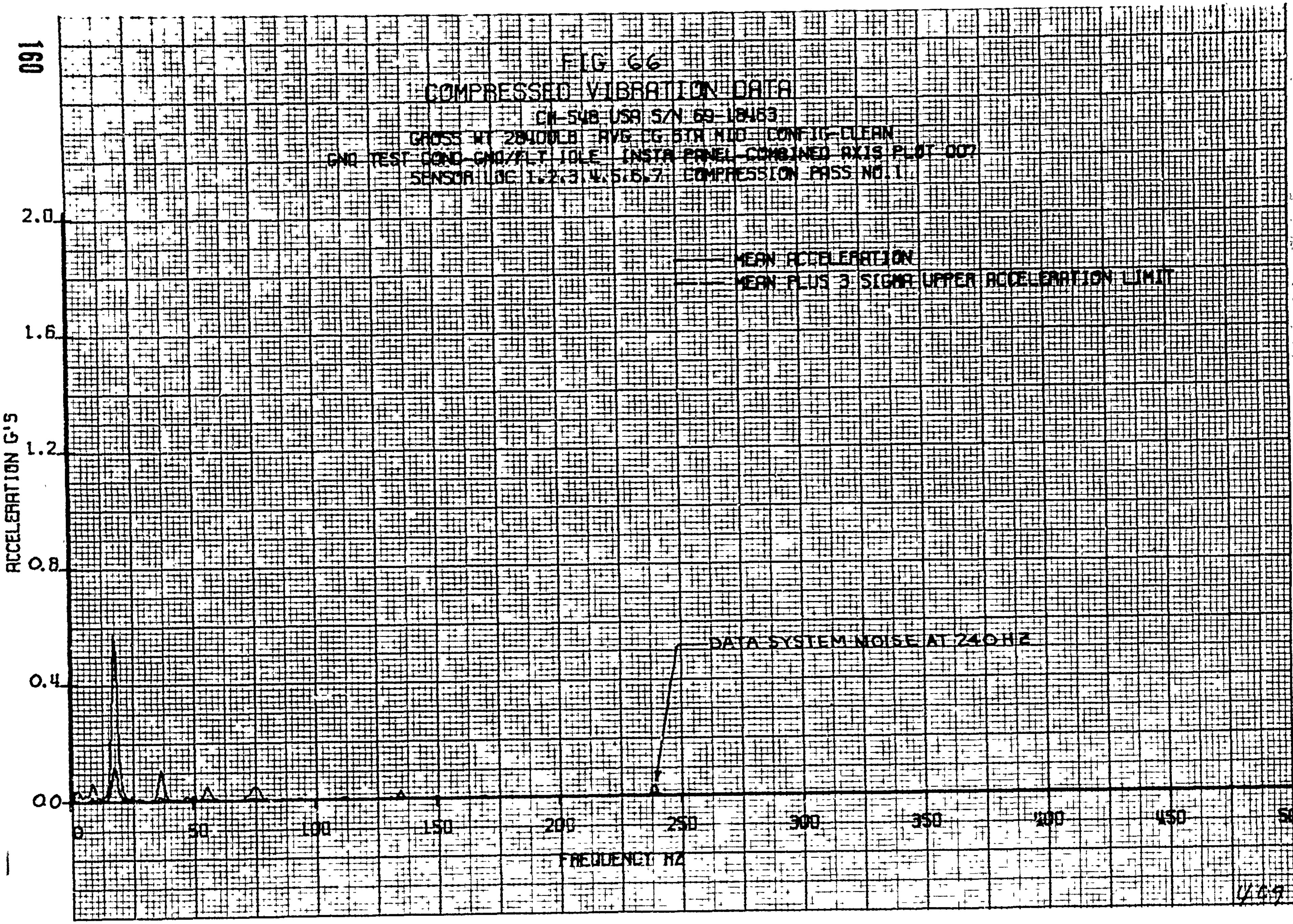


FIG 66
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400LB AVG CG STA MID CONFIG-CLEAN
GND TEST COND-GND/FLT IDLE INSTR PANEL-COMBINED AXIS PLOT 007
SENSOR LOC 1,2,3,4,5,6,7 COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240 HZ
ACCELERATION G'S
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

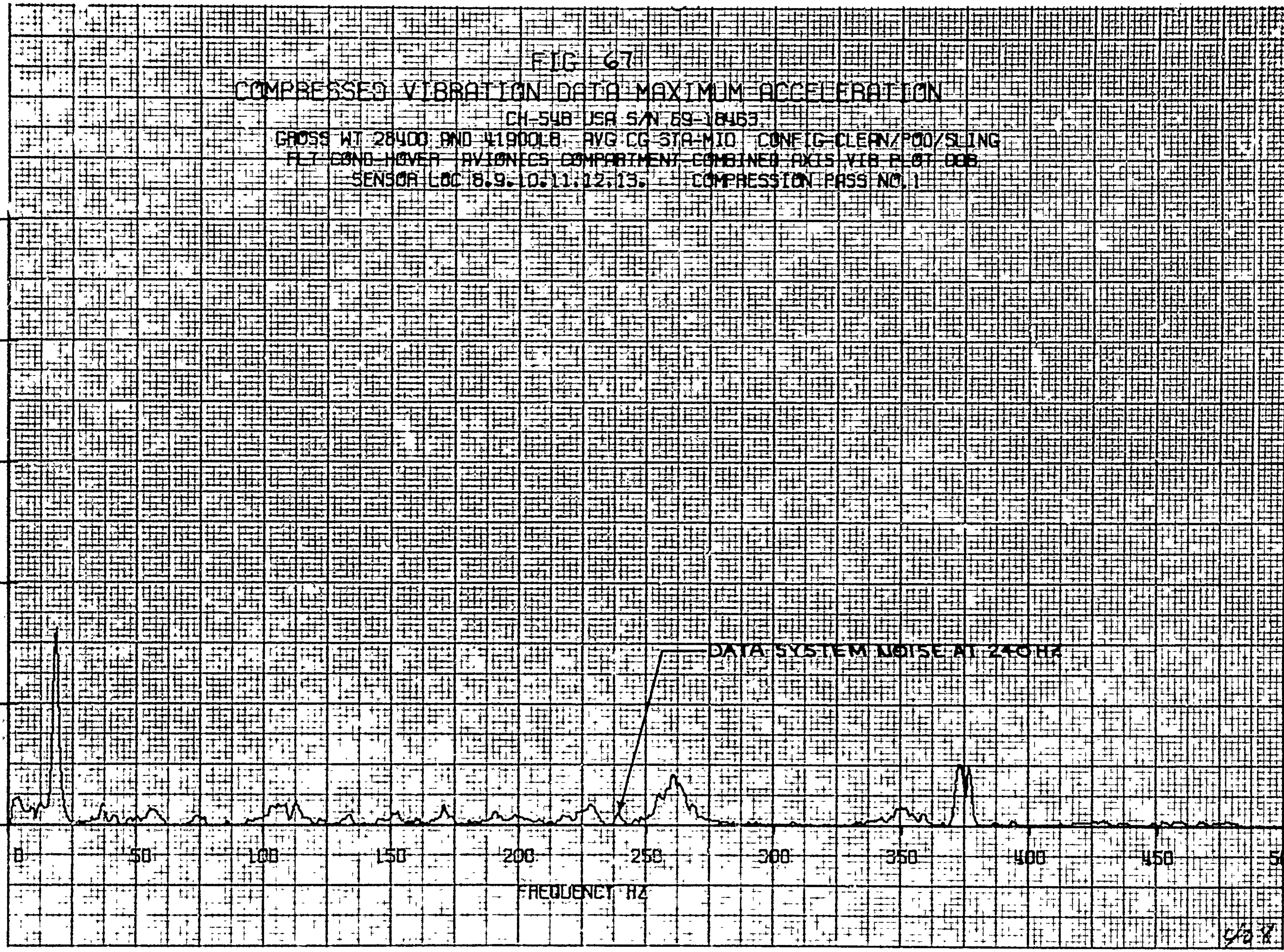


FIG 67
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

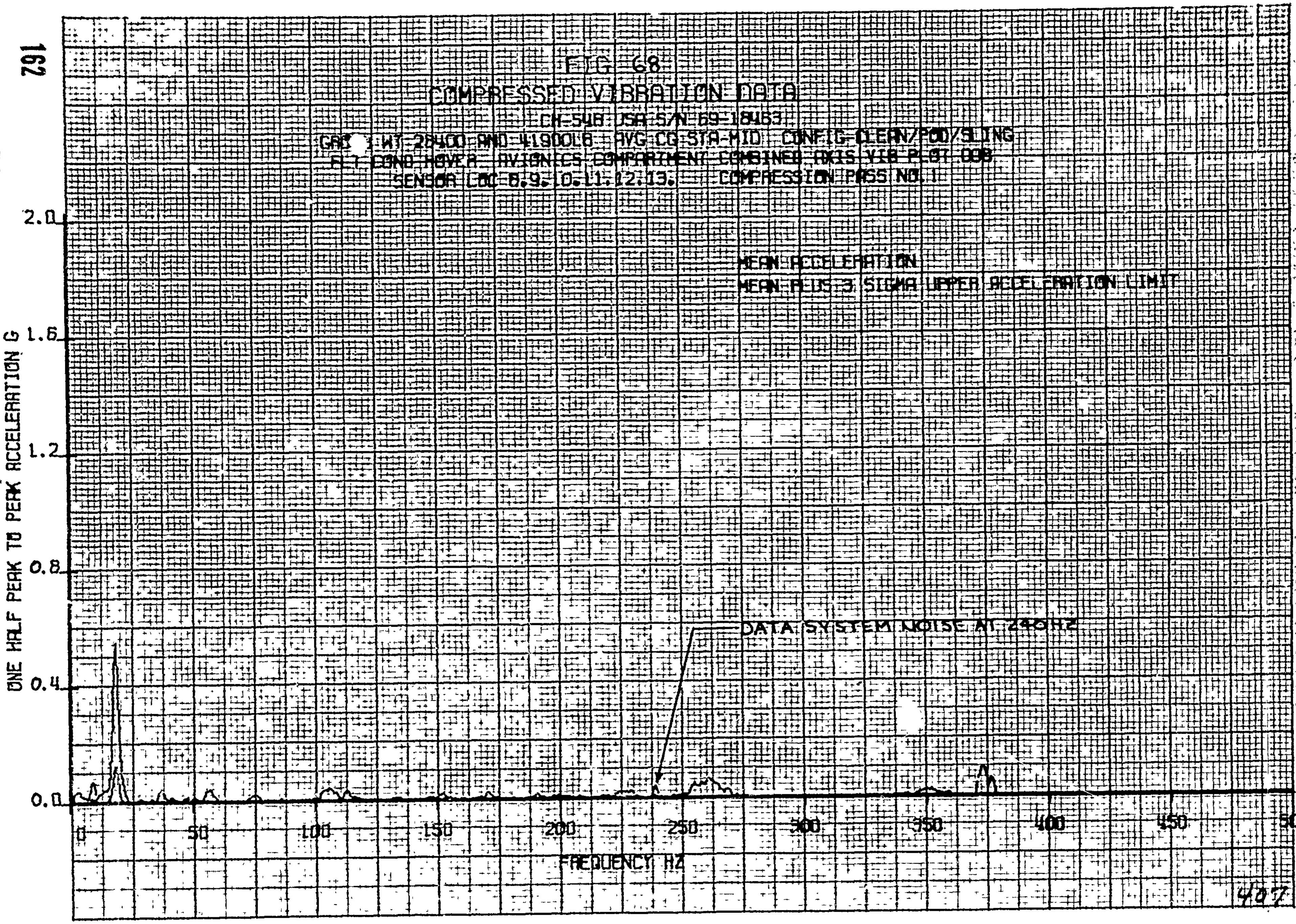


FIG 68
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND HOVER AVIONICS COMPARTMENT COMBINED AXIS VIB PLOT 008
SENSOR LOC 8.9.10.11.12.13. COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240HZ
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ
407

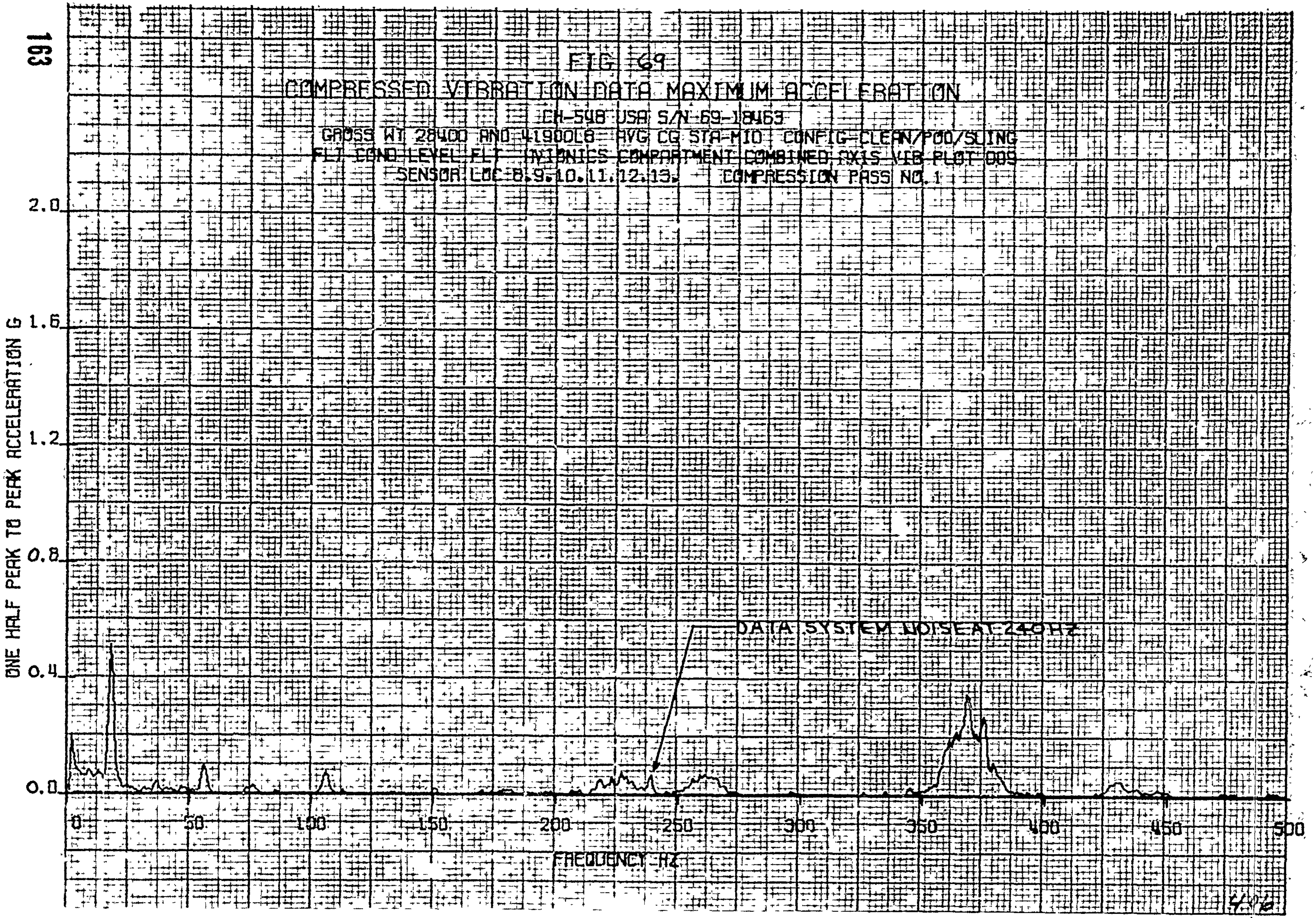


FIG 69
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND LEVEL FLT AVIONICS COMPARTMENT COMBINED AXIS VIB PLOT 009
SENSOR LOC 8.9.10.11.12.13. COMPRESSION PASS NO.1
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

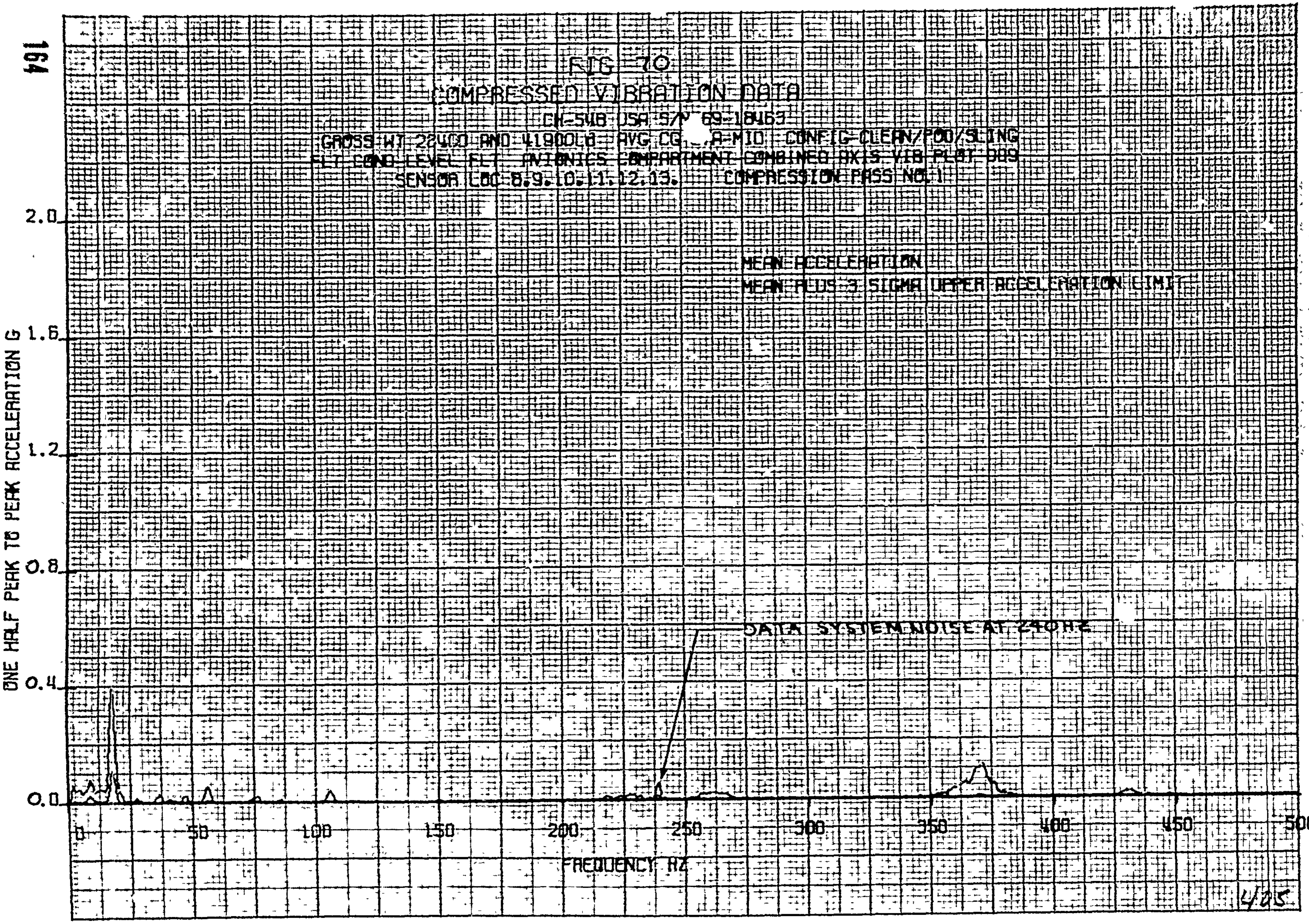


FIG. 70
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 22400 AND 41900LB AVG CG A-MID CONFIG-CLEAN/POD/SLING
FLT COND LEVEL FLT AVIONICS COMPARTMENT COMBINED AXIS VIB PLOT 009
SENSOR LOC 8.9.10.11.12.13. COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ
405

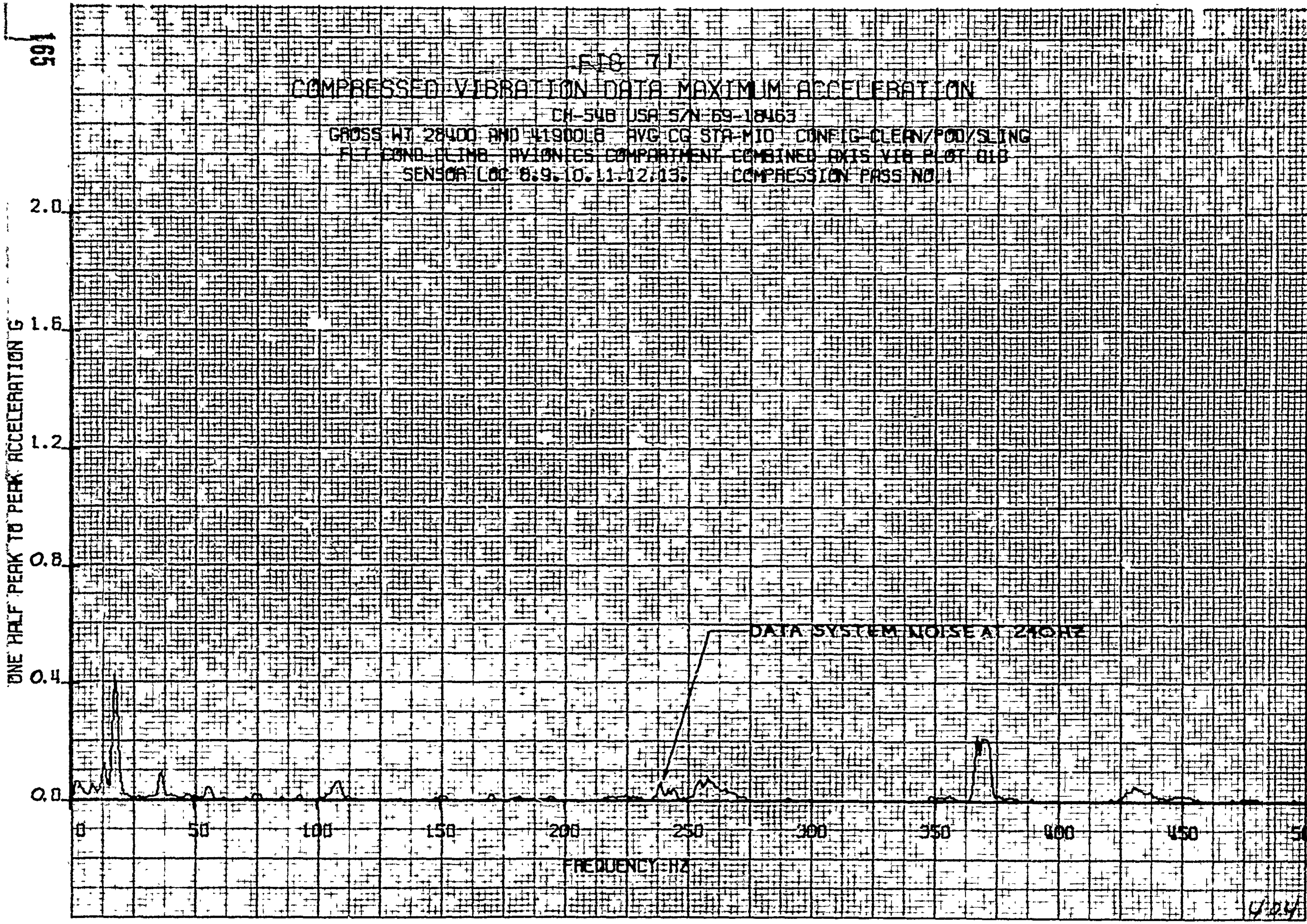


FIG 71
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-CLIMB AVIONICS COMPARTMENT COMBINED AXIS VIB PLOT 018
SENSOR LOC 8.9.10.11.12.13. COMPRESSION PASS NO.1
DATA SYSTEM NOISE AT 240HZ
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY-HZ
U-24

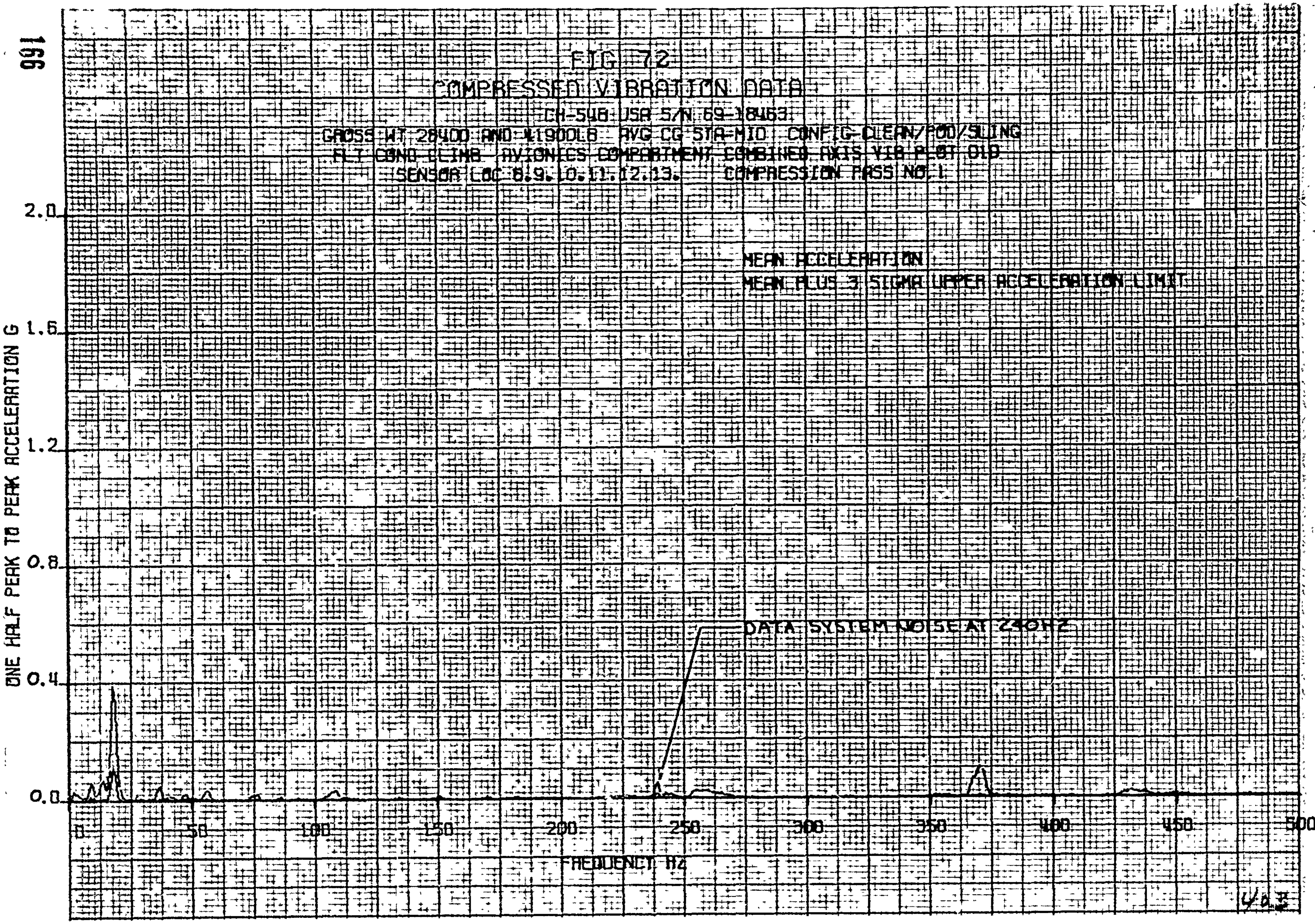


FIG 72
COMPRESSED VIBRATION DATA

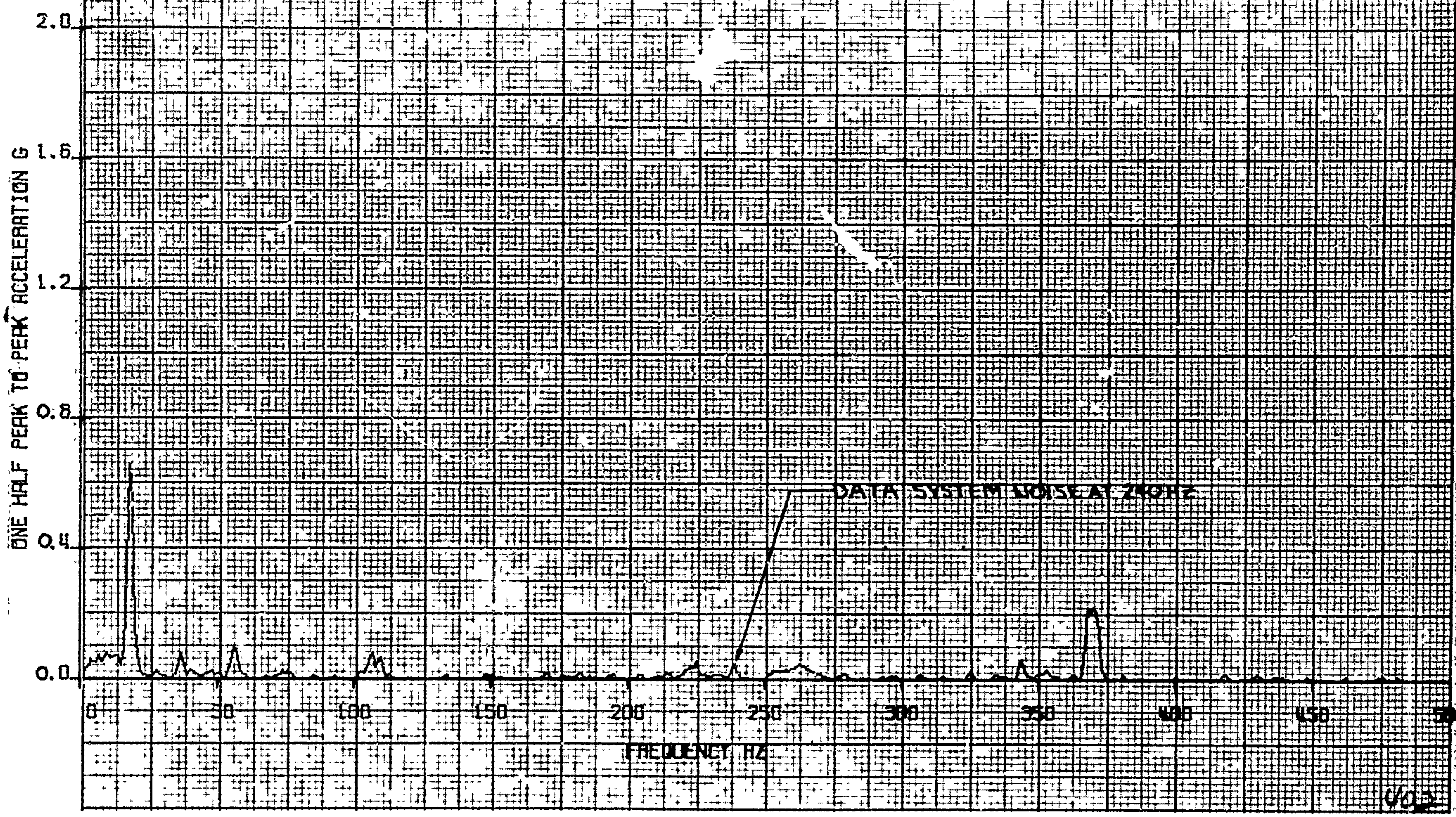


FIG 73
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28100 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-DESCENT AVIONICS COMPARTMENT-COMBINED AXIS VIB PLOT 011
SENSOR LOC 8.9.10.11.12.13. COMPRESSION PASS NO 1

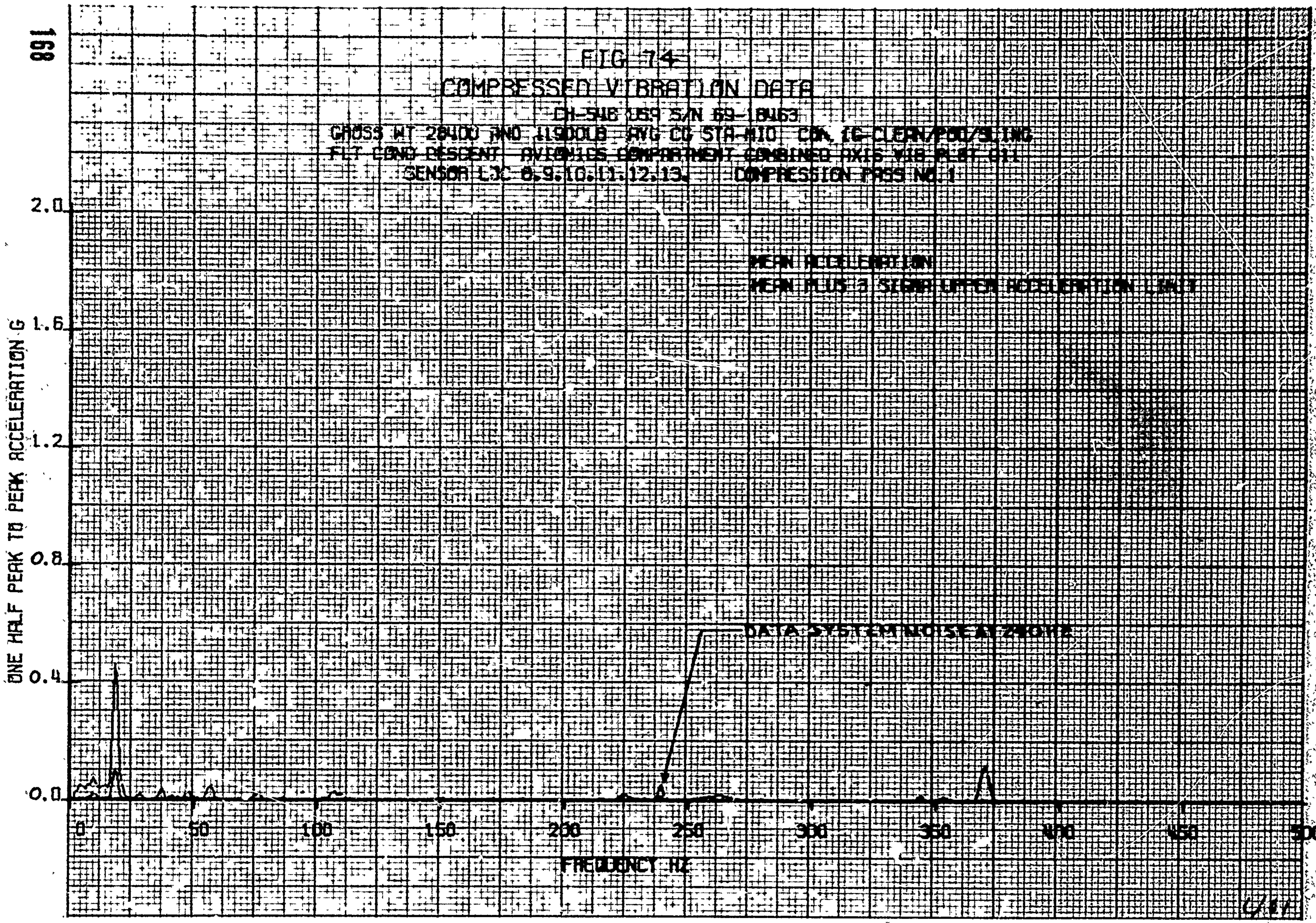


FIG 74
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 11900LB AVG CG STA-MID CON. IG-CLEAN/POD/SLING
FLT COND DESCENT AVIONICS COMPARTMENT COMBINED AXIS VIB PLOT 011
SENSOR LOC 8.9.10.11.12.13. COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240HZ
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

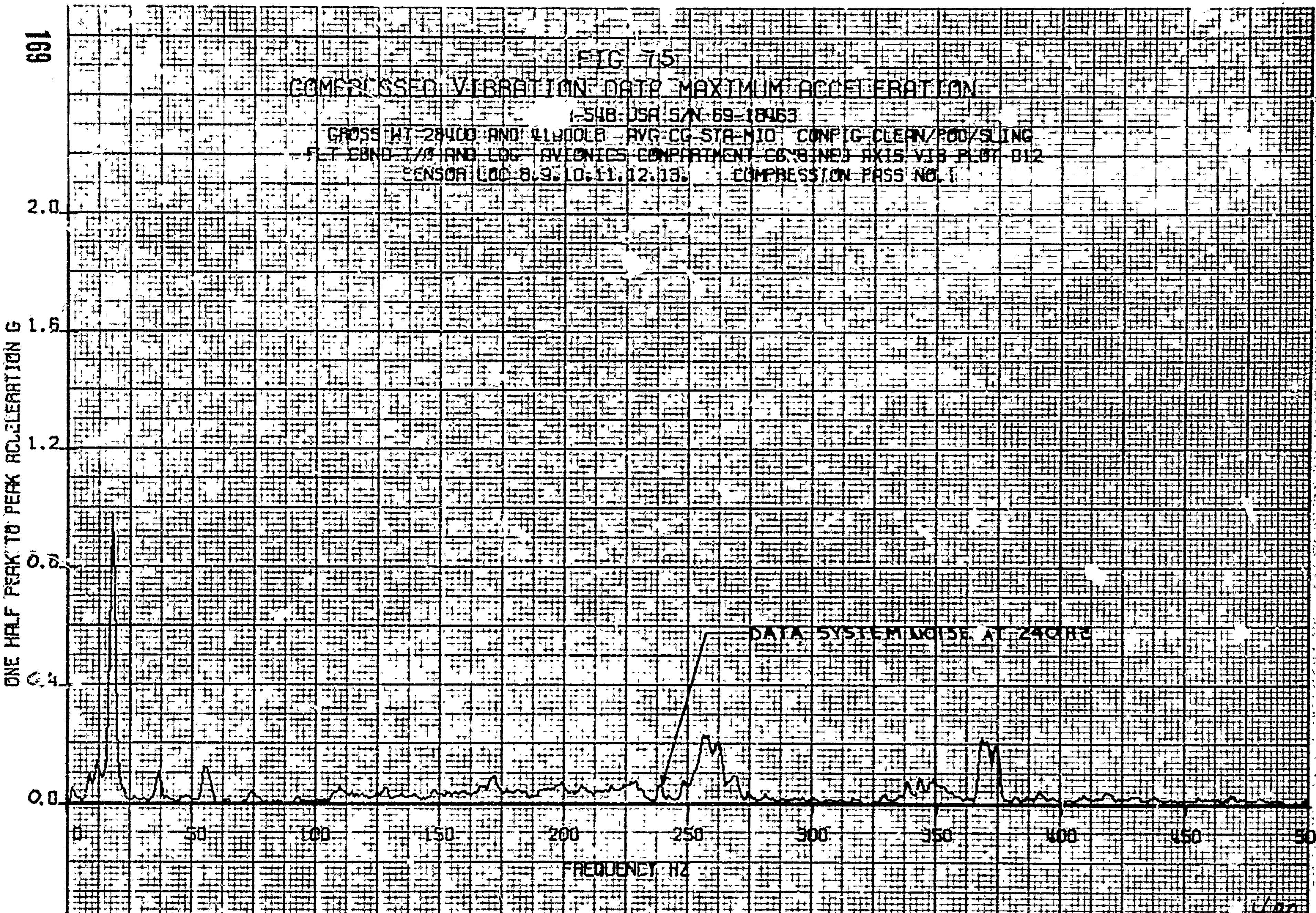


FIG 75
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
-54B USA S/N 69-18963
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND T/O AND LDG AVIONICS COMPARTMENT COMBINED AXIS VIB PLOT 012
SENSOR LOC 8.9.10.11.12.13. COMPRESSION PASS NO.1
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

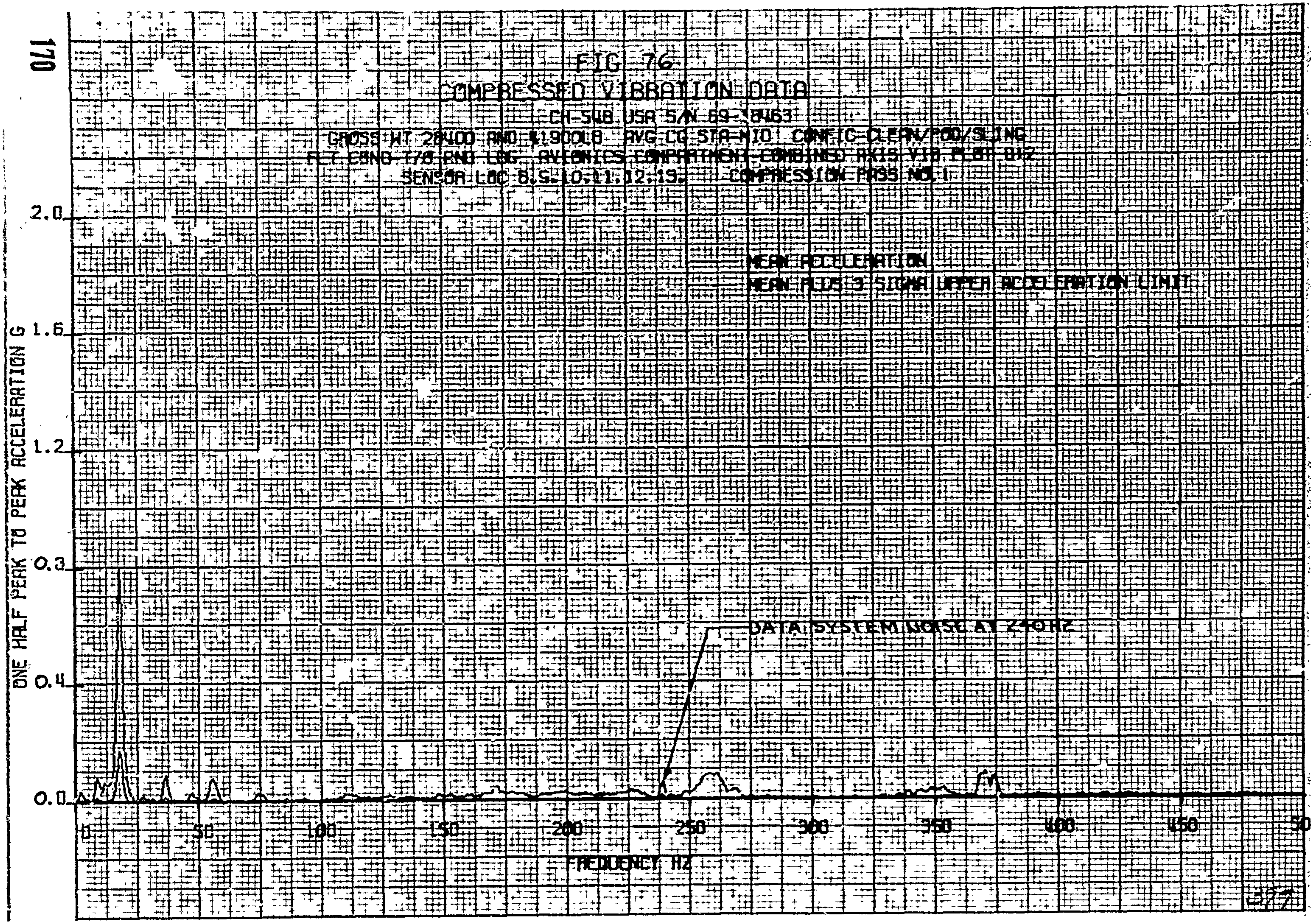


FIG 76
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-T/O AND LDG. AVIONICS COMPARTMENT COMBINED AXIS VIB PLOT 8X2
SENSOR LOC 8.9.10.11.12.19. COMPRESSION PASS NO. 1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.3
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

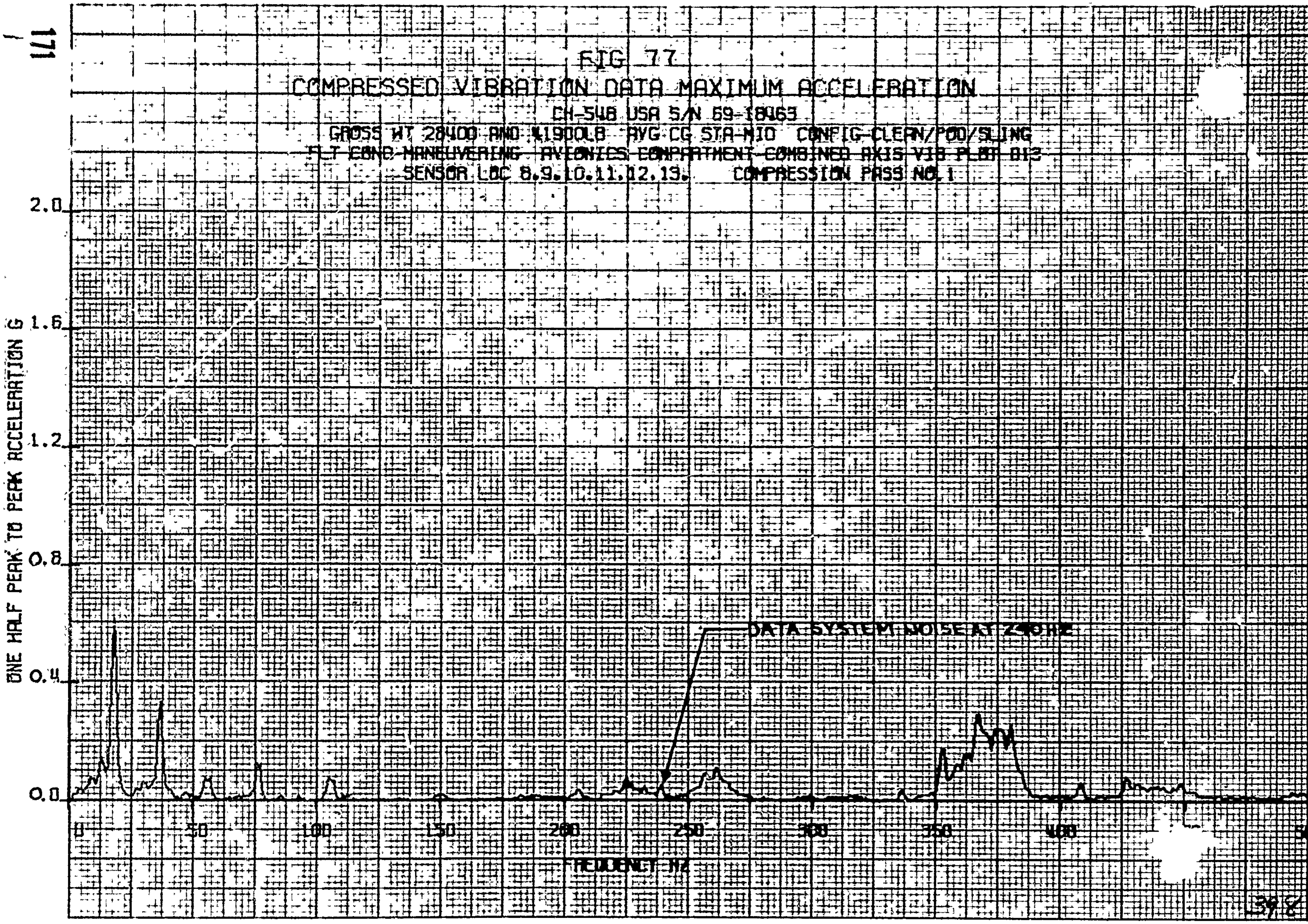


FIG 77
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-MANEUVERING AVIONICS COMPARTMENT-COMBINED AXIS V18 PLOT 013
SENSOR LOC 8.9.10.11.12.13. COMPRESSION PASS NO.1
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
DATA SYSTEM NOISE AT 240 HZ
0
50
100
150
200
250
300
350
400
500
FREQUENCY HZ
398

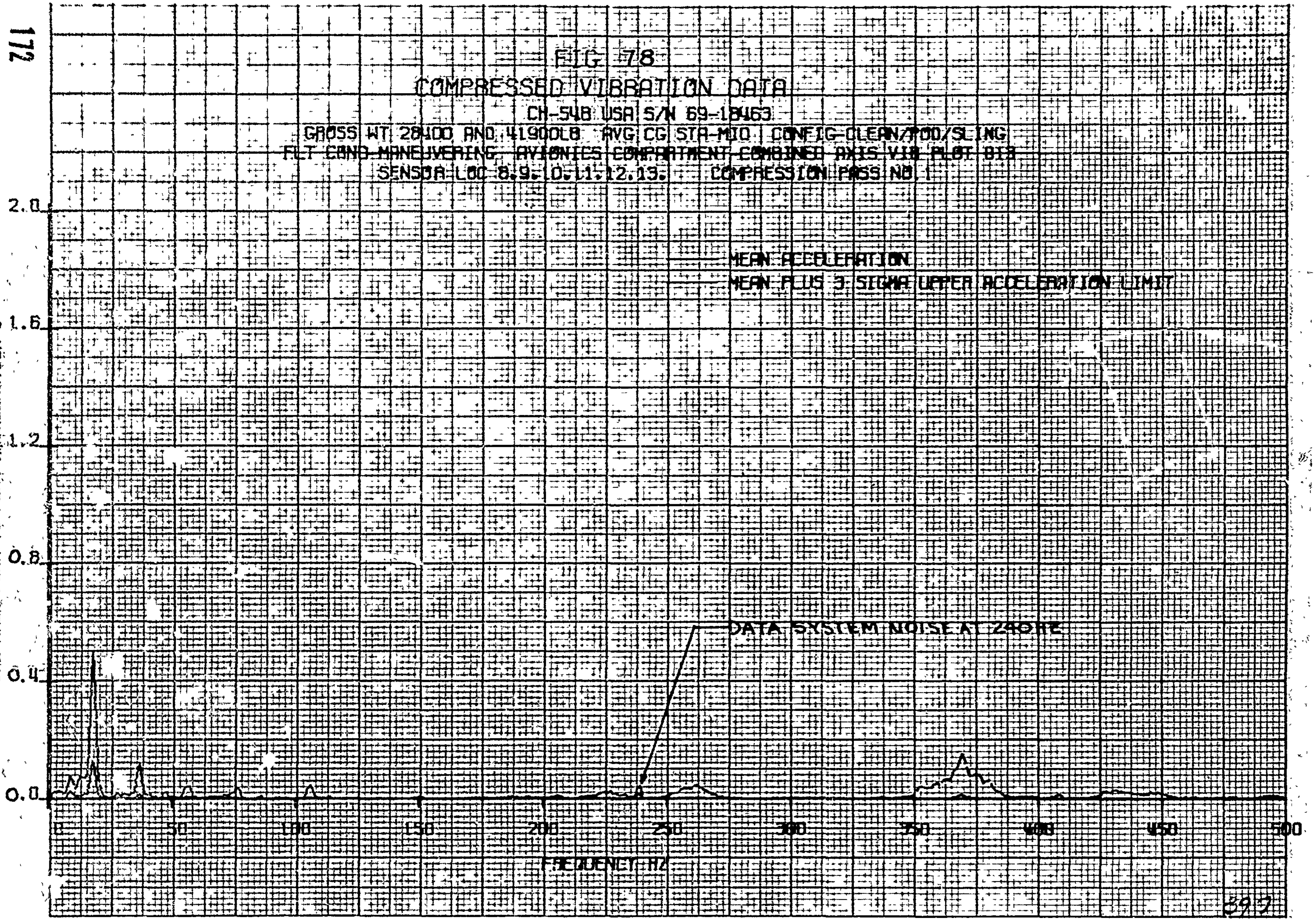


FIG 78
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-MANEUVERING AVIONICS COMPARTMENT COMBINED AXIS V18 PLOT 813
SENSOR LOC 8.9.10.11.12.13. COMPRESSION PASS NO 1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240HZ
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ
397

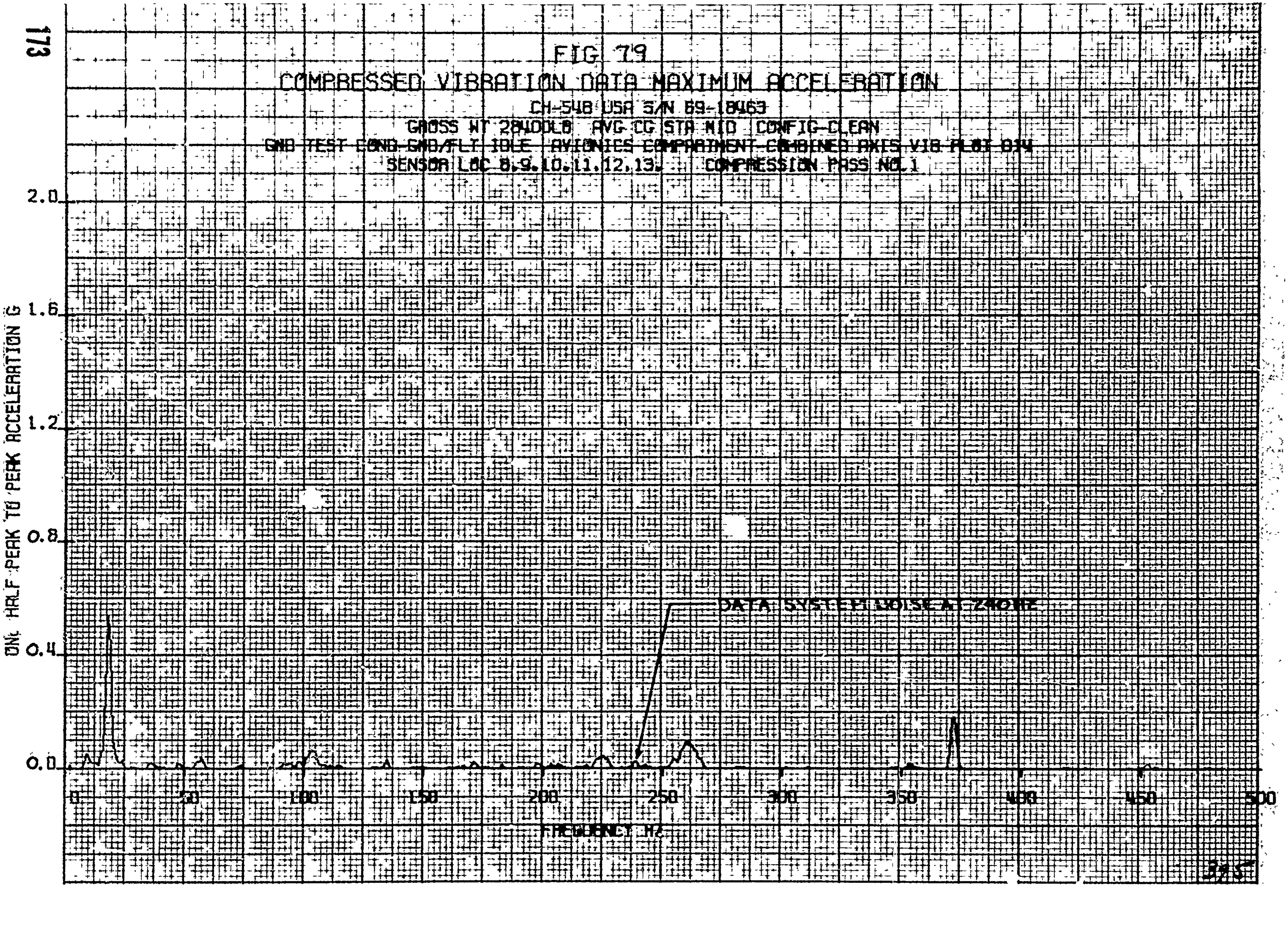


FIG 79
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400LB AVG CG STA MID CONFIG-CLEAN
GND TEST COND-GND/FLT IDLE AVIONICS COMPARTMENT COMBINED AXIS VIB PLOT 034
SENSOR LOC 8.9.10.11.12.13. COMPRESSION PASS NO.1
DATA SYSTEM NOISE AT 240HZ
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ
395

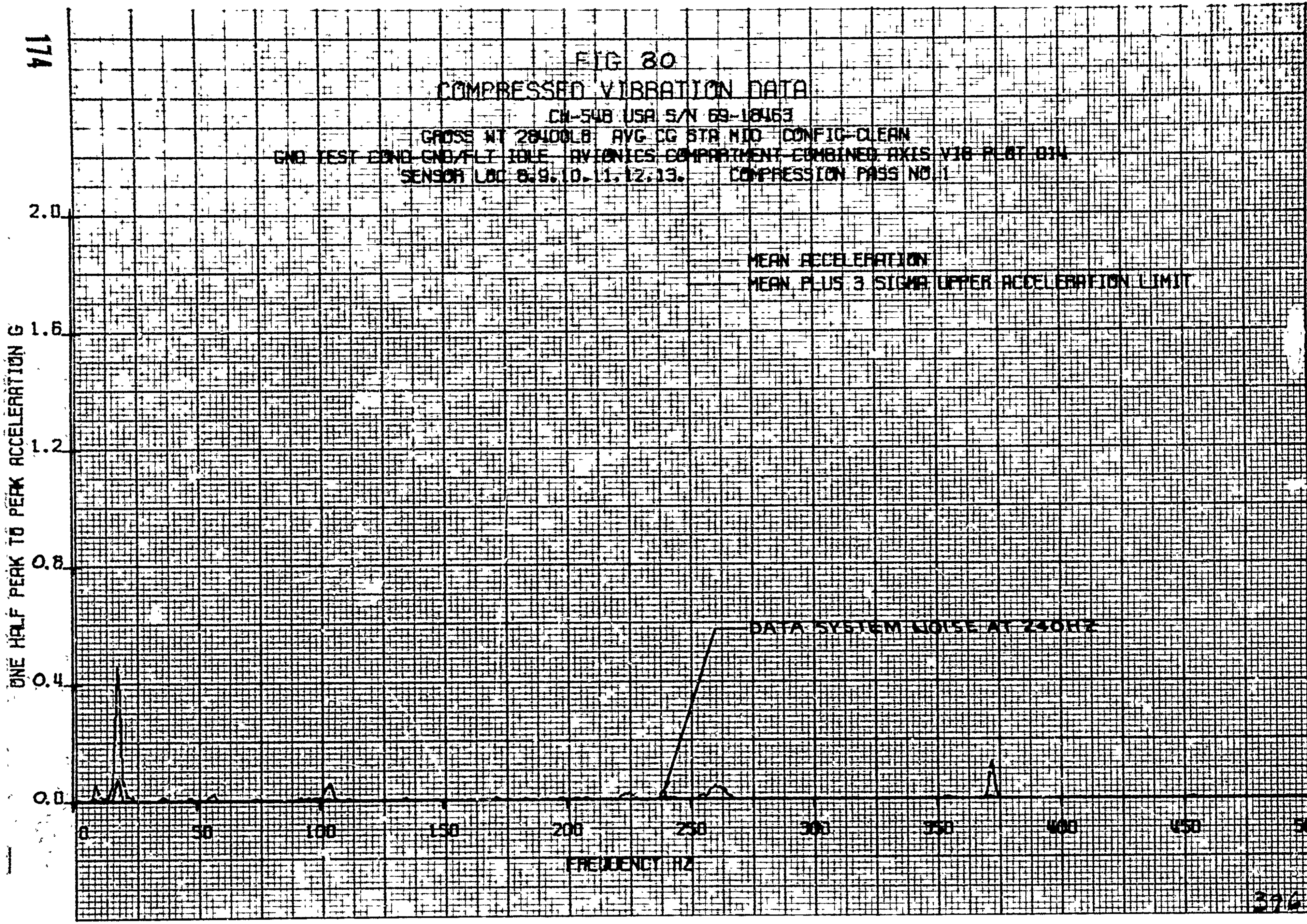


FIG 80
COMPRESSED VIBRATION DATA

FIG 81

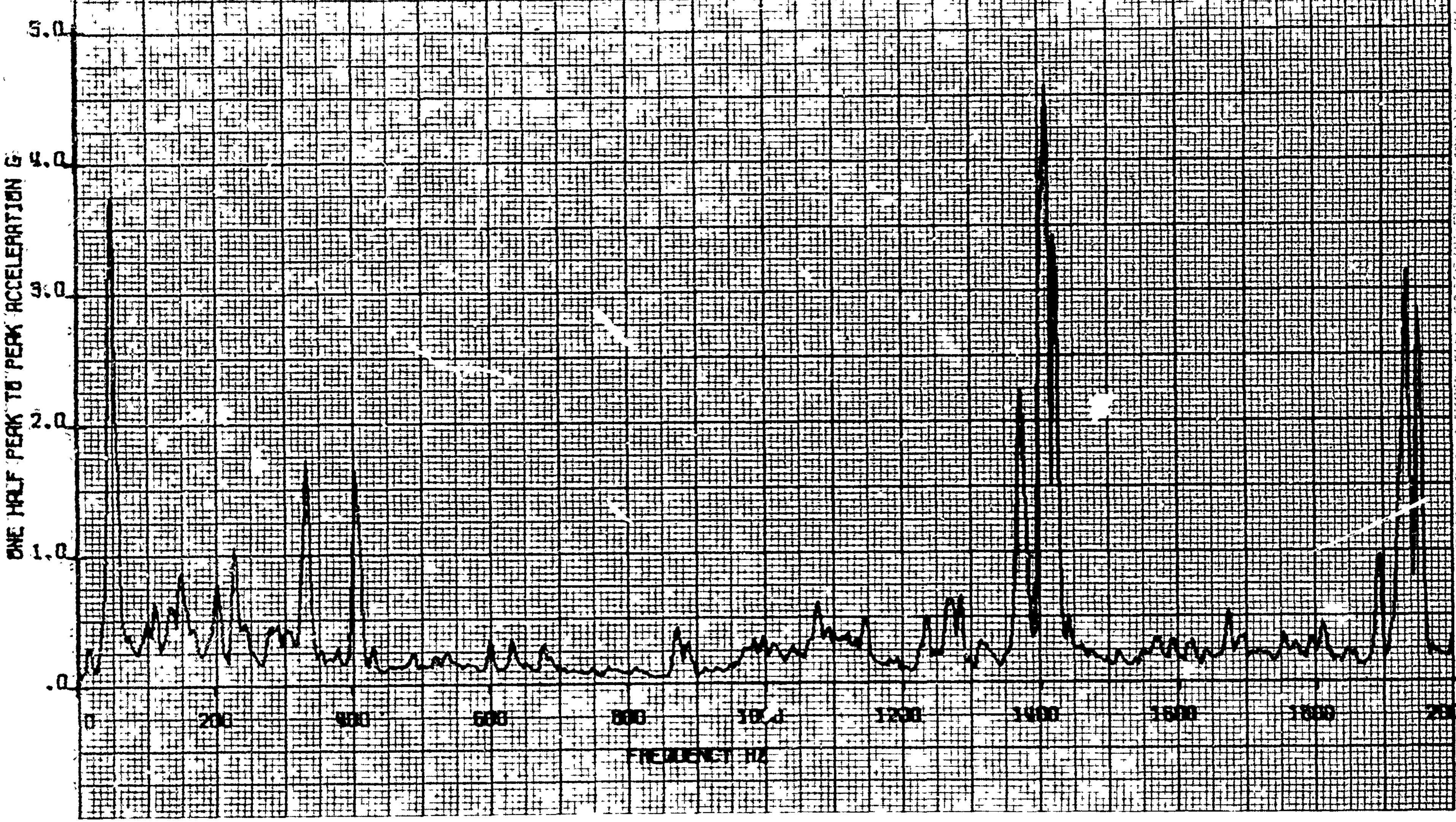
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

FLT COND HOVER AVIONICS AFT FUSELAGE COMBINED AXIS VIB PLOT 5015

SENSOR LOC 14.40.56 SPECIAL PURPOSE COMPRESSION



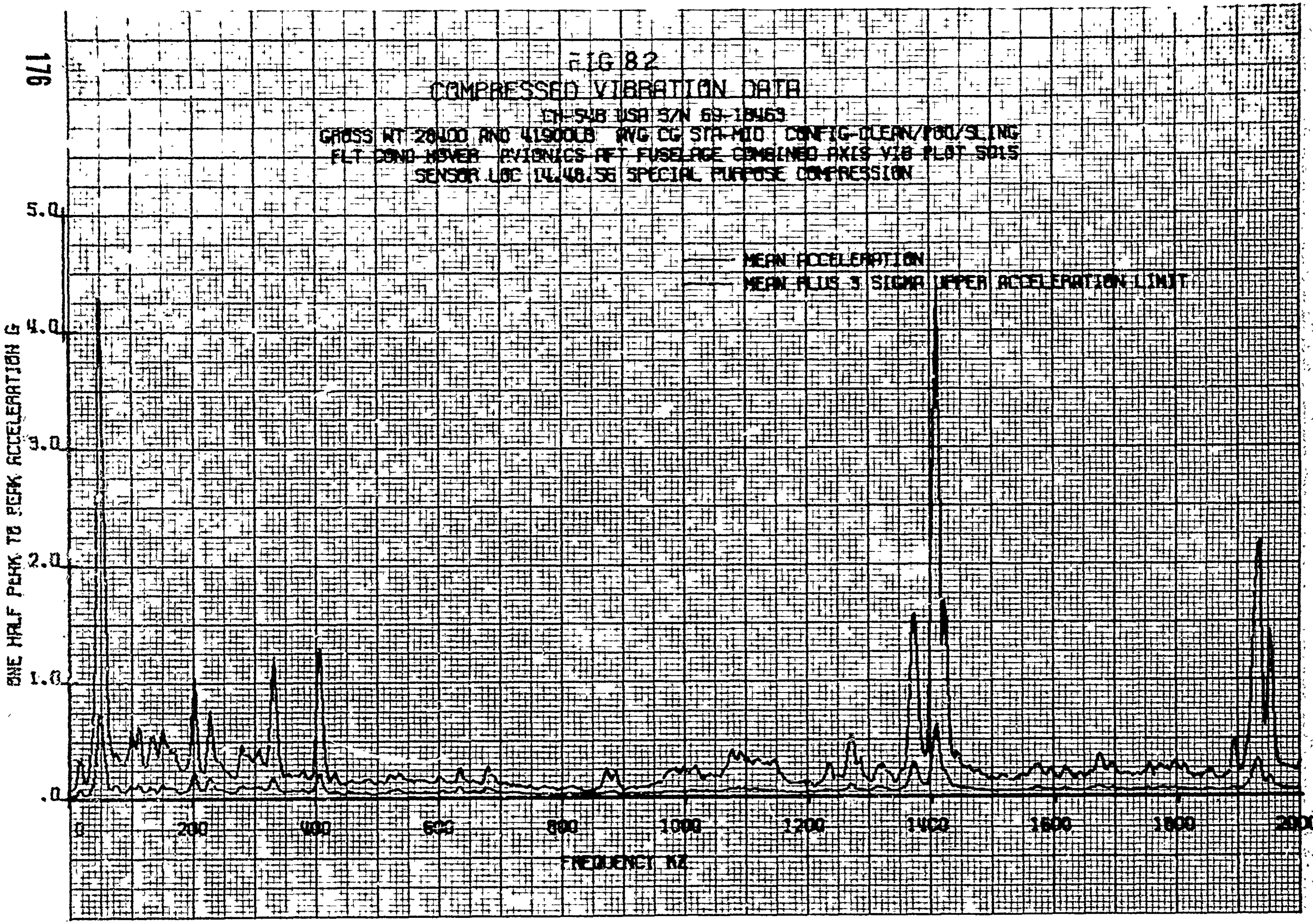


FIG 82
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND HOVER AVIONICS AFT FUSELAGE COMBINED AXIS VIB PLOT S015
SENSOR LOC 14,48.56 SPECIAL PURPOSE COMPRESSION
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
5.0
4.0
3.0
2.0
1.0
.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

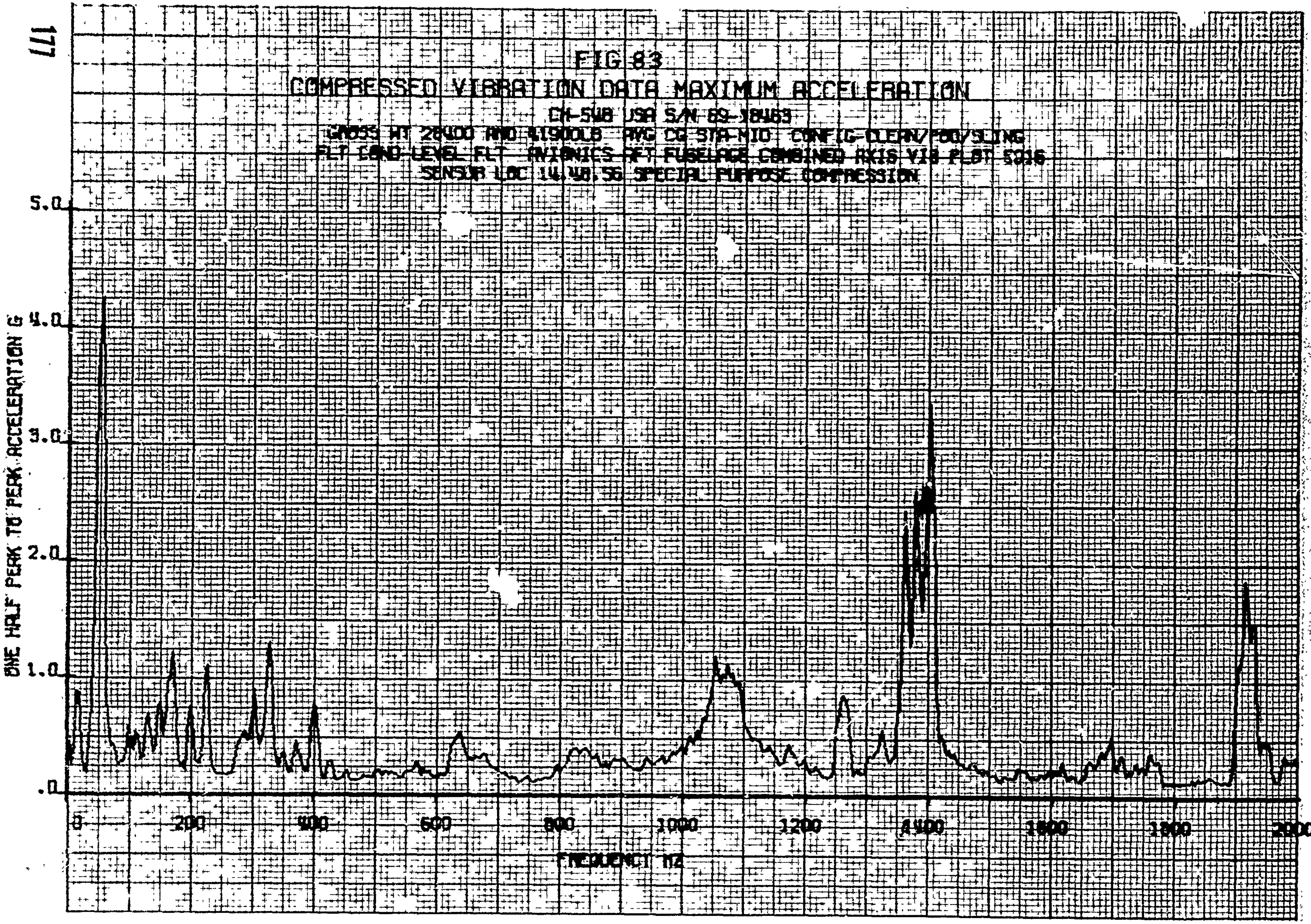


FIG 83
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-LEVEL FLT AVIONICS AFT FUSELAGE COMBINED AXIS VIB PLOT 5016
SENSOR LOC 14,48,56 SPECIAL PURPOSE COMPRESSION
ONE HALF PEAK TO PEAK ACCELERATION G
5.0
4.0
3.0
2.0
1.0
.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

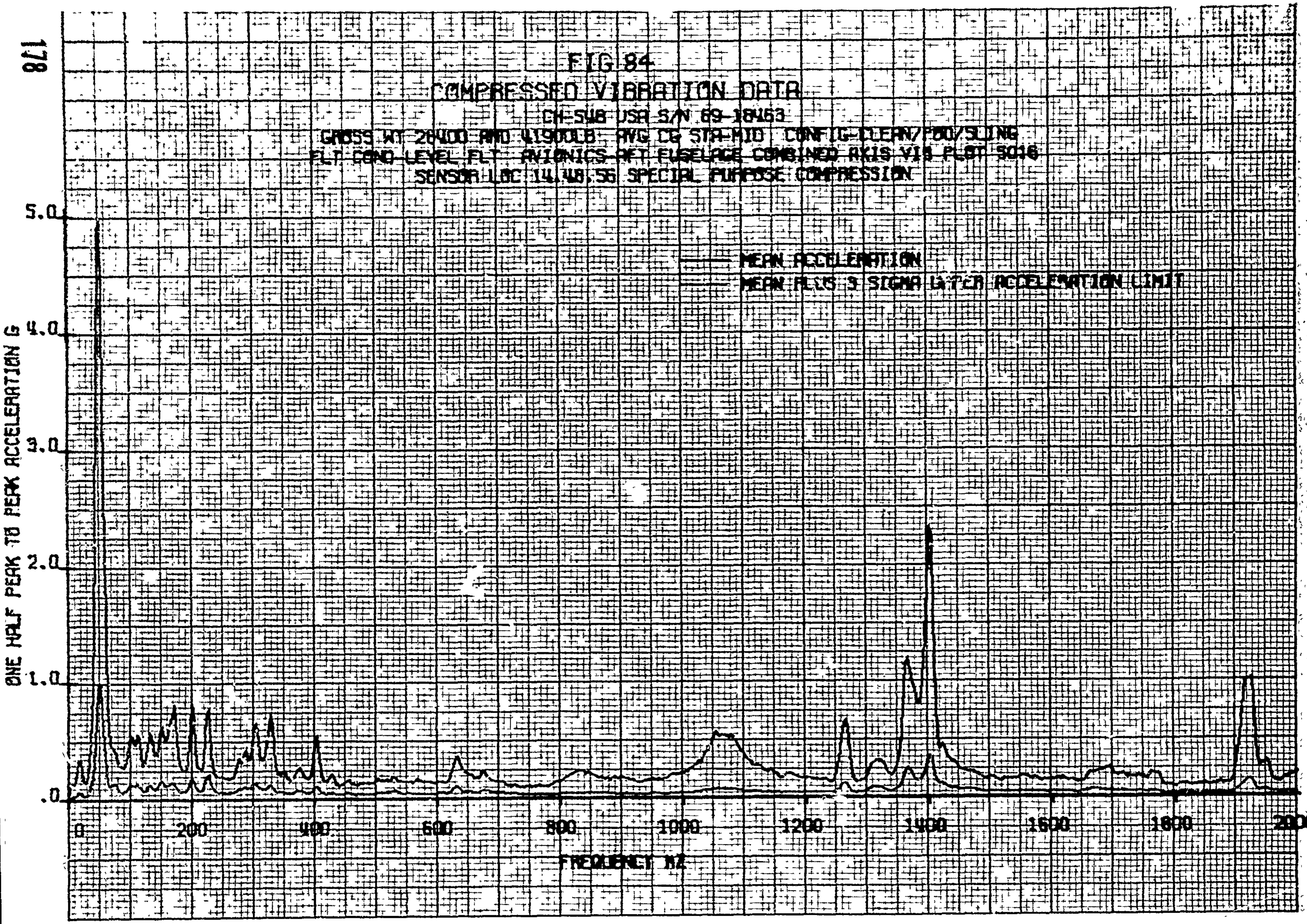


FIG 84
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 20400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND LEVEL FLT AVIONICS-AFT FUSELAGE COMBINED AXIS VIB PLOT 5016
SENSOR LOC 14,48,56 SPECIAL PURPOSE COMPRESSION
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
5.0
4.0
3.0
2.0
1.0
.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

FIG 85

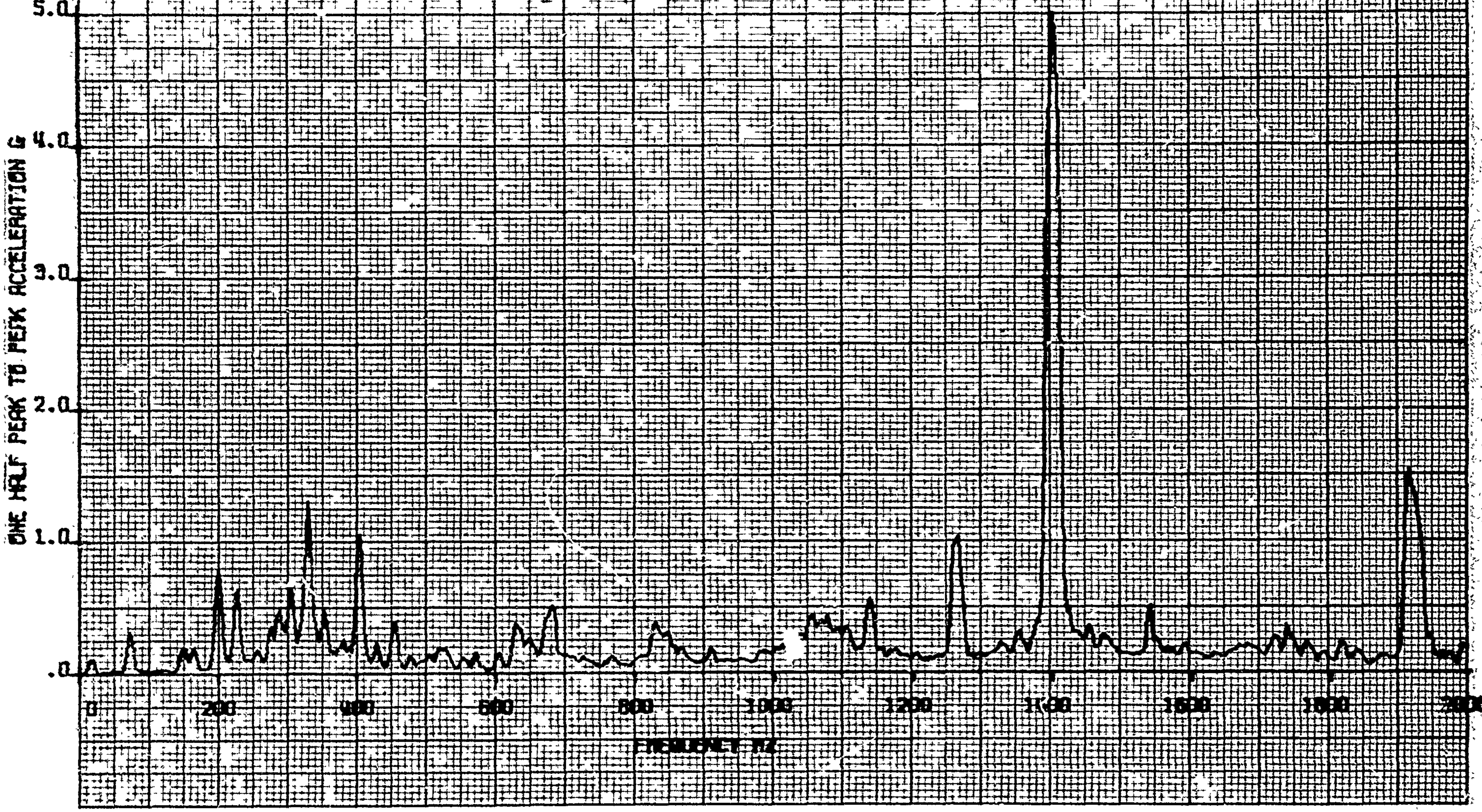
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION

CH-54B USA S/N 69-18463

GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING

FLT COND CLIMB AVIONICS AFT FUSELAGE COMBINED AXIS VIB PLOT SD17

SENSOR LOC 14.48.56 SPECIAL PURPOSE COMPRESSION



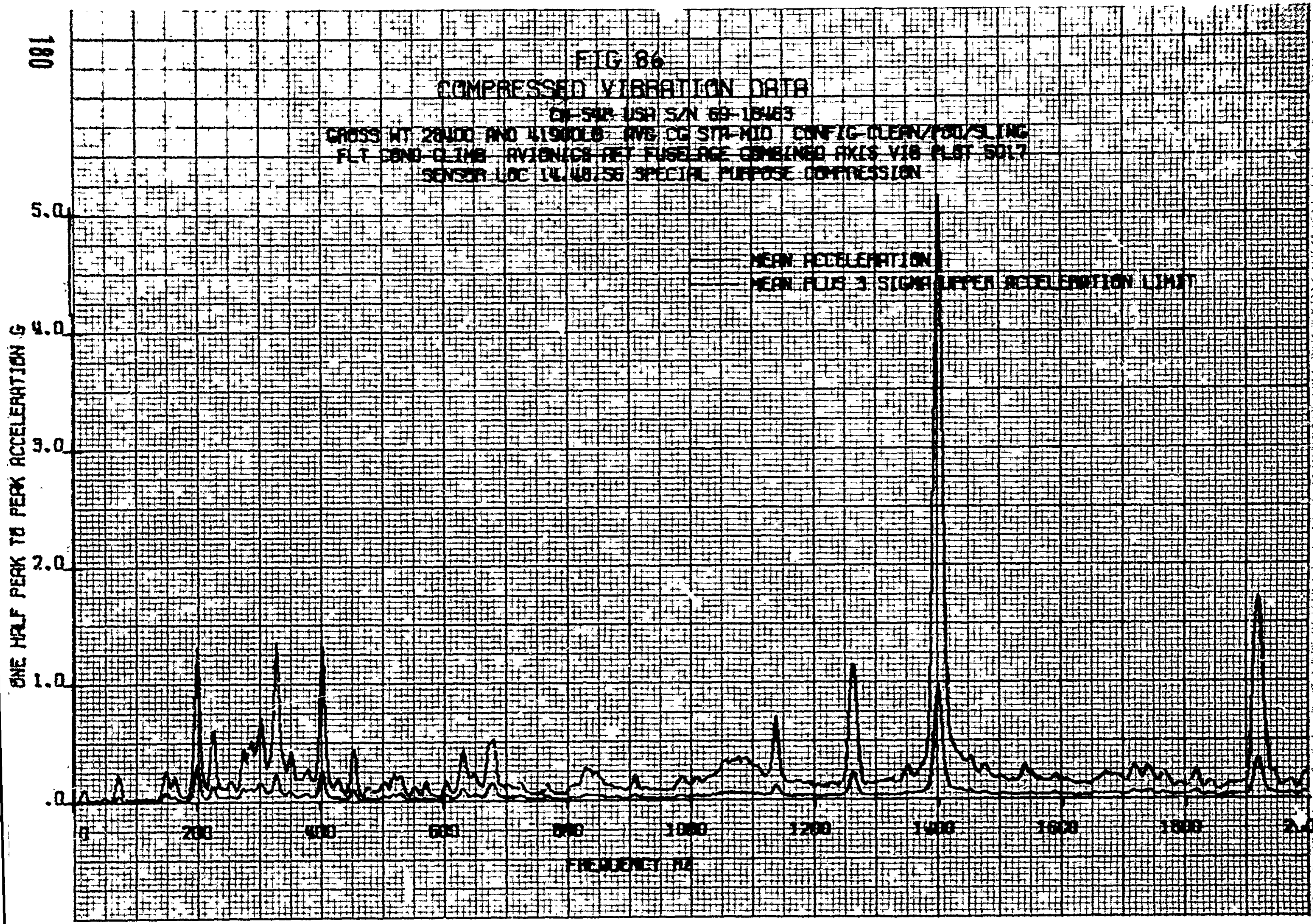


FIG 86
COMPRESSED VIBRATION DATA
CH-54A USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-CLIMB AVIONICS RET FUSELAGE COMBINED AXIS VIB PLOT S017
SENSOR LOC 14.48.56 SPECIAL PURPOSE COMPRESSION
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
5.0
4.0
3.0
2.0
1.0
.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

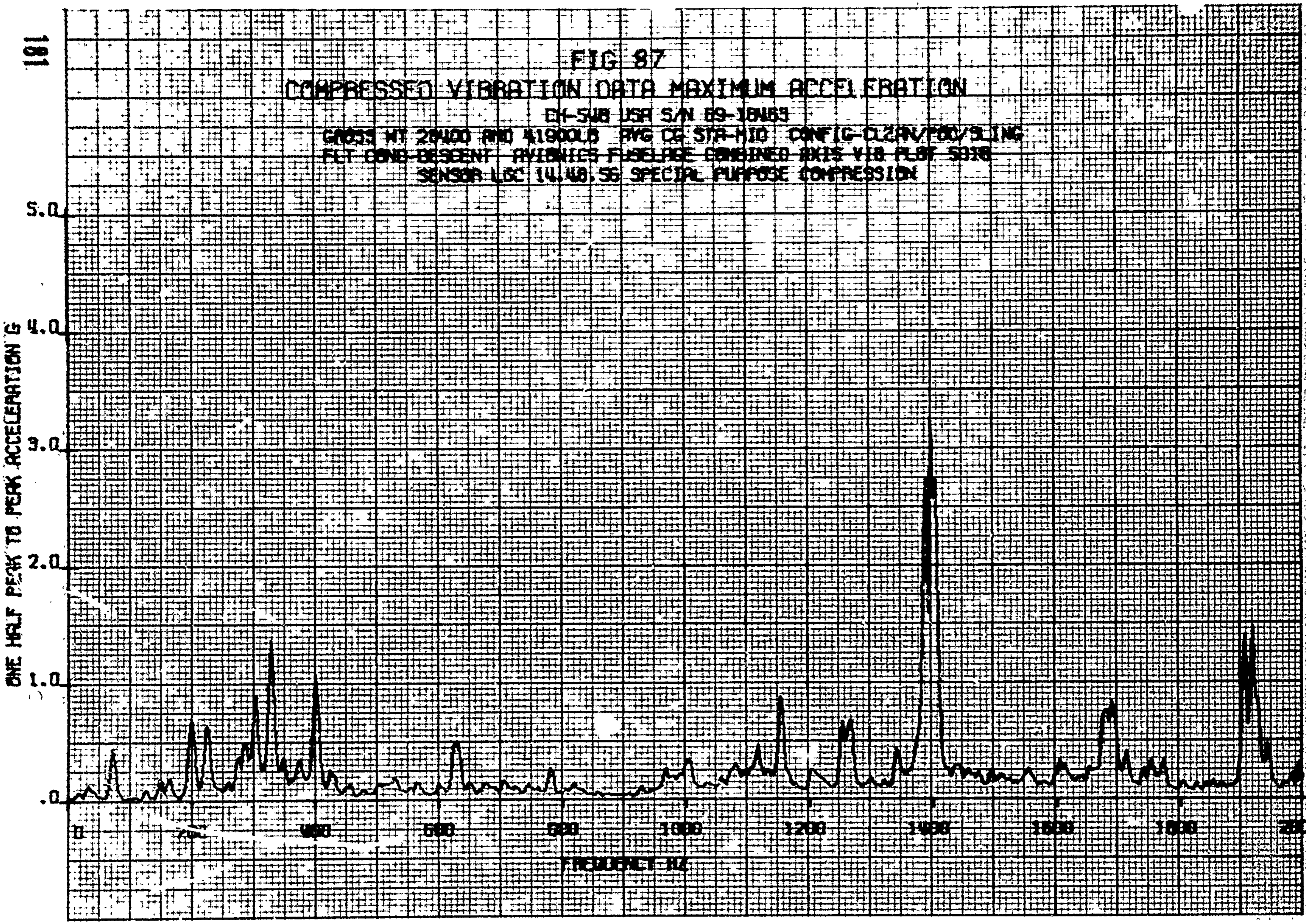


FIG 87
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 20400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-DESCENT AVIONICS FUSELAGE COMBINED AXIS V18 PLOT 5818
SENSOR LOC 14.48.56 SPECIAL PURPOSE COMPRESSION
5.0
4.0
3.0
2.0
1.0
.0
ONE HALF PEAK TO PEAK ACCELERATION G
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

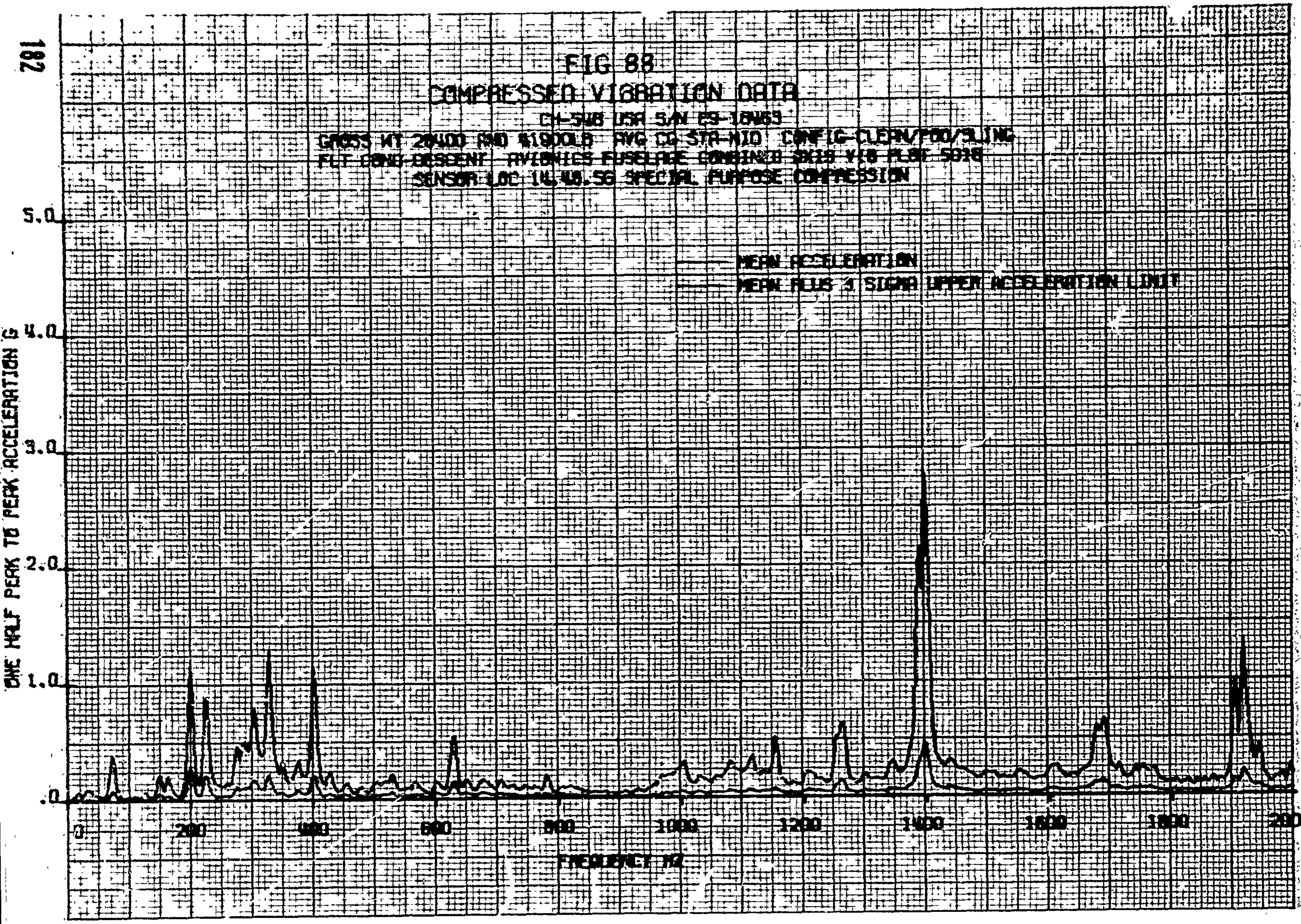


FIG 88
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 20400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-DESCENT AVIONICS FUSELAGE COMBINED 3X18 Y/8 PL8F 5818
SENSOR LOC 14.40.56 SPECIAL PURPOSE COMPRESSION
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
5.0
4.0
3.0
2.0
1.0
.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

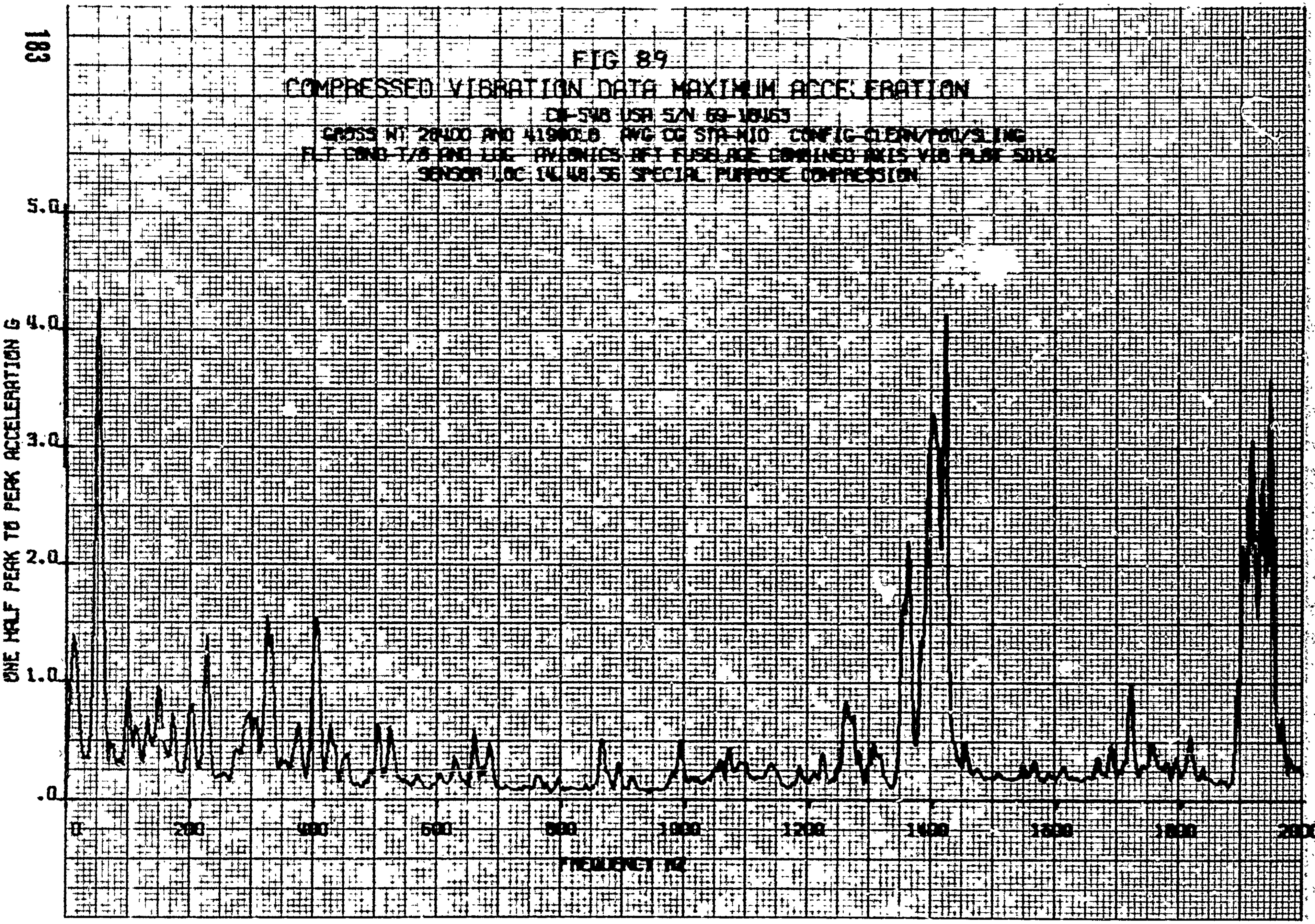


FIG 89
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900.0 AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND T/O AND LDG AVIONICS AFT FUSELAGE COMBINED AXIS VIB PLOT 5013
SENSOR LOC 14.40.56 SPECIAL PURPOSE COMPRESSION
ONE HALF PEAK TO PEAK ACCELERATION G
5.0
4.0
3.0
2.0
1.0
.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

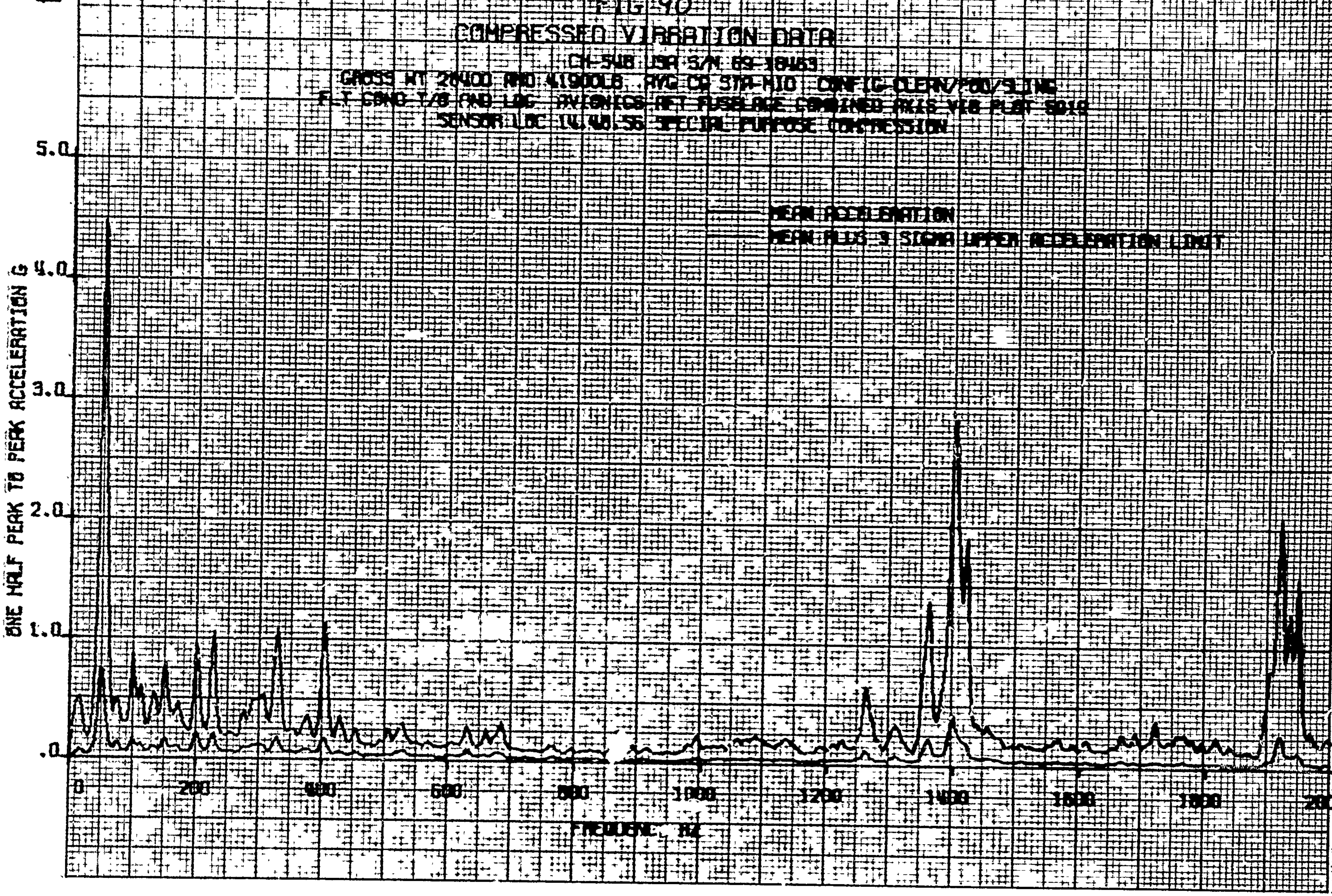


FIG 90
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 20400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
F-T COND T/O AND LDG AVIONICS AFT FUSELAGE COMBINED AXIS VIB PLOT SD19
SENSOR LOC 14.40.56 SPECIAL PURPOSE COMPRESSION

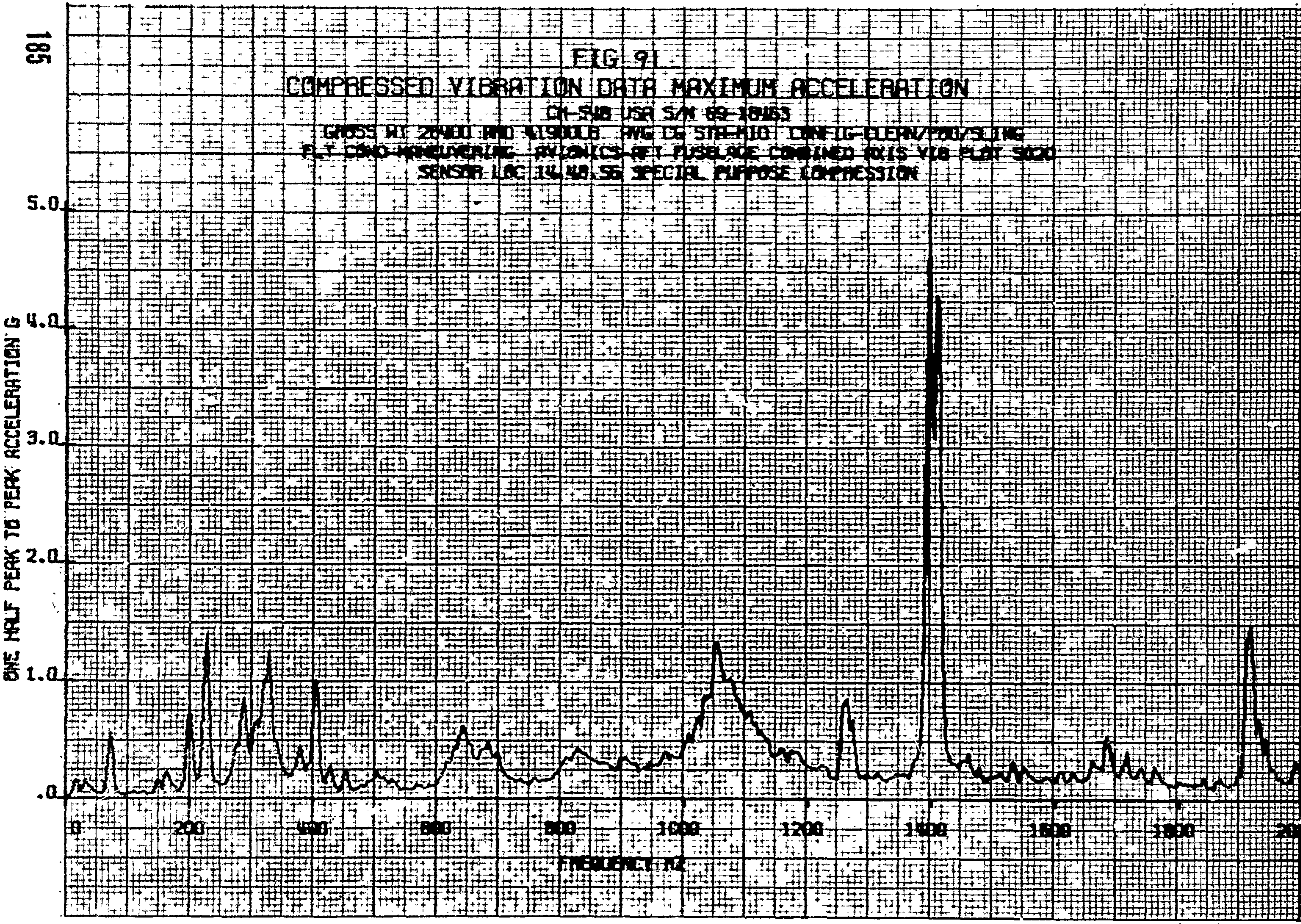


FIG 91
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-MANEUVERING AVIONICS-AFT FUSELAGE COMBINED AXIS VIB PLOT 5020
SENSOR LOC 14.40.56 SPECIAL PURPOSE COMPRESSION
ONE HALF PEAK TO PEAK ACCELERATION G
5.0
4.0
3.0
2.0
1.0
.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

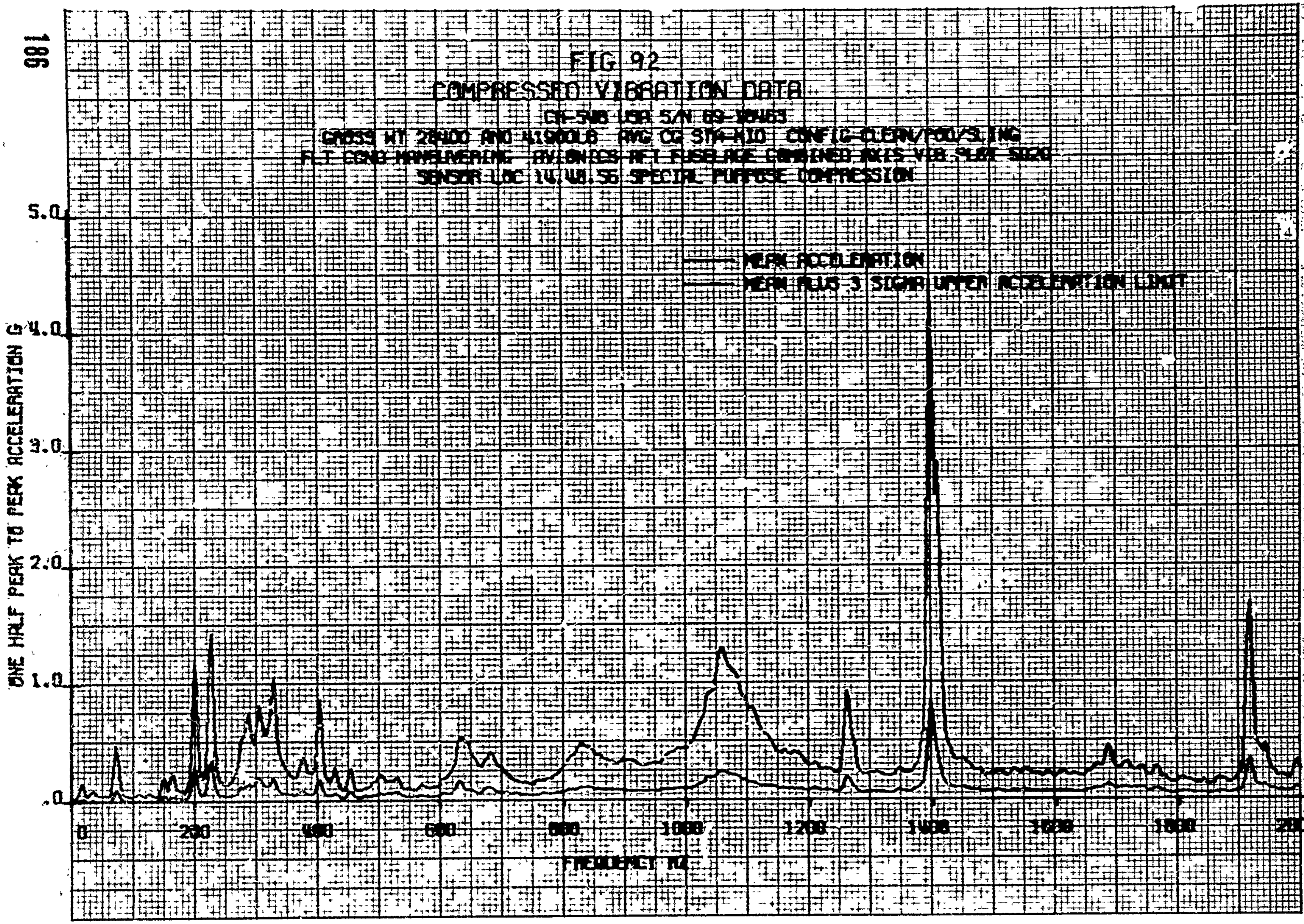


FIG 92
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-410 CONFIG-CLEAN/POD/SLING
FLT COND MANEUVERING AVIONICS AFT FUSELAGE COMBINED AXIS VIB SLOT S020
SENSOR LOC 14,48,56 SPECIAL PURPOSE COMPRESSION
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
5.0
4.0
3.0
2.0
1.0
.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

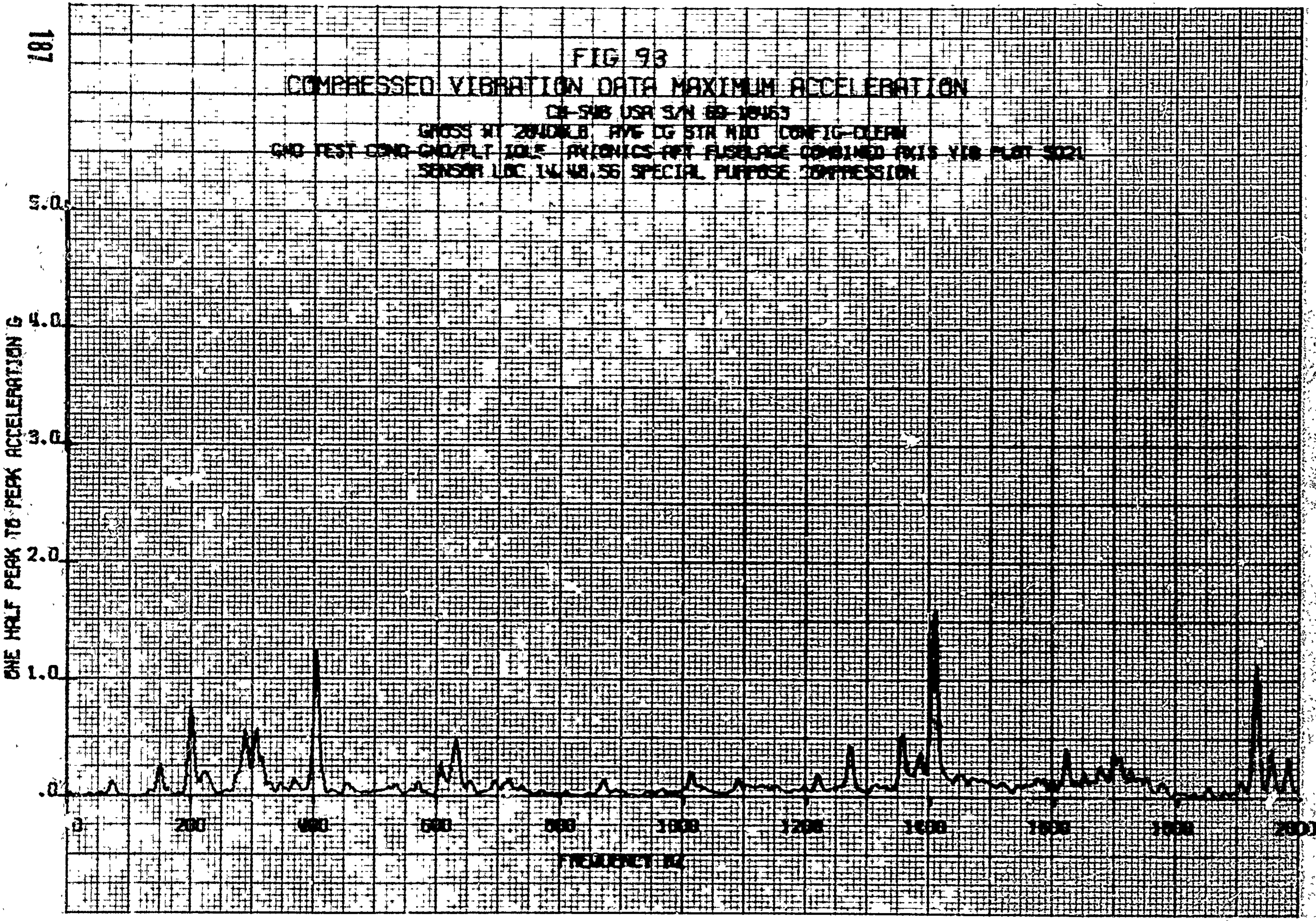


FIG 93
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
SPECIAL PURPOSE COMPRESSION
ONE HALF PEAK TO PEAK ACCELERATION G
5.0
4.0
3.0
2.0
1.0
.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

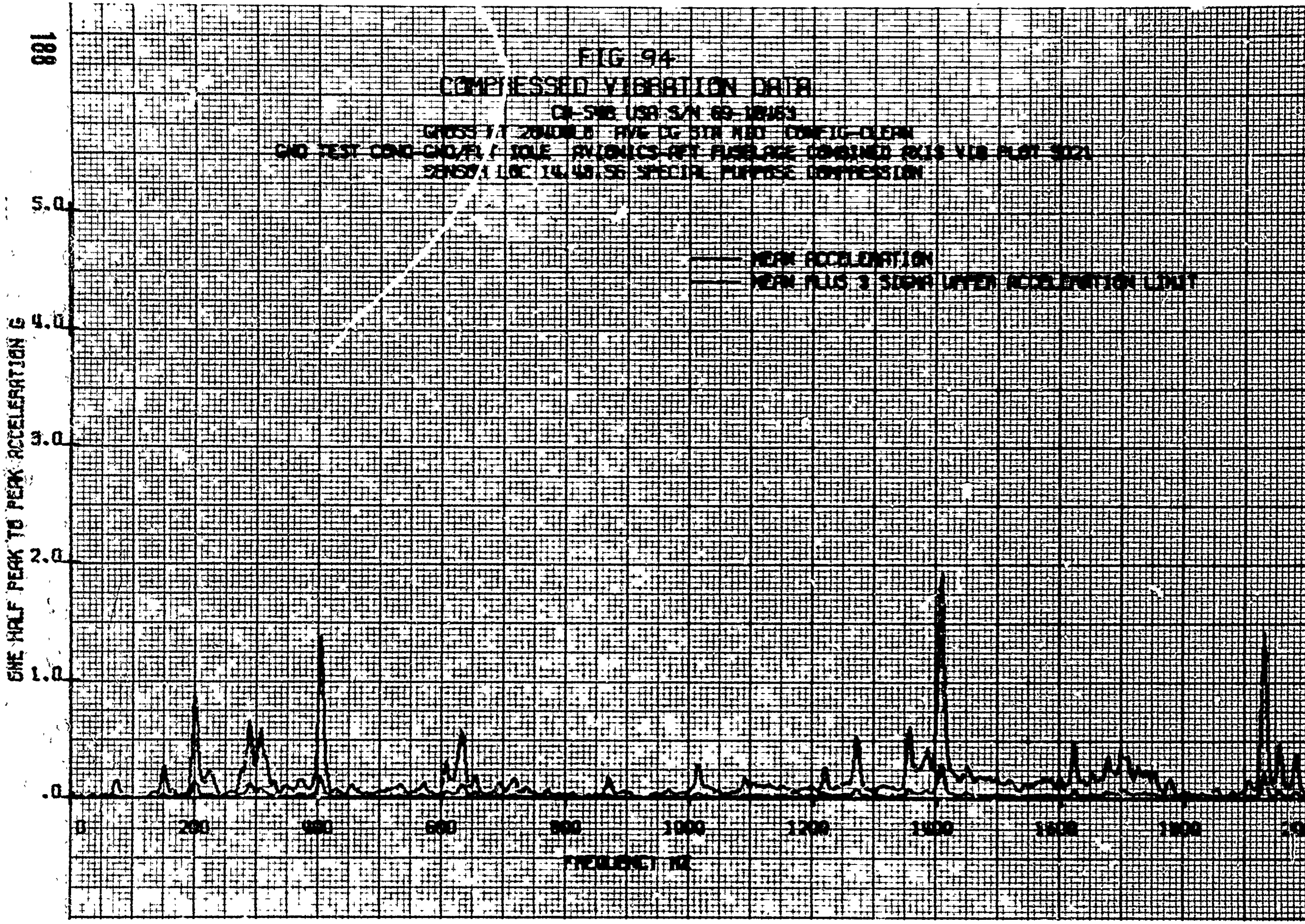


FIG 94
COMPRESSED VIBRATION DATA
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
5.0
4.0
3.0
2.0
1.0
.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY HZ

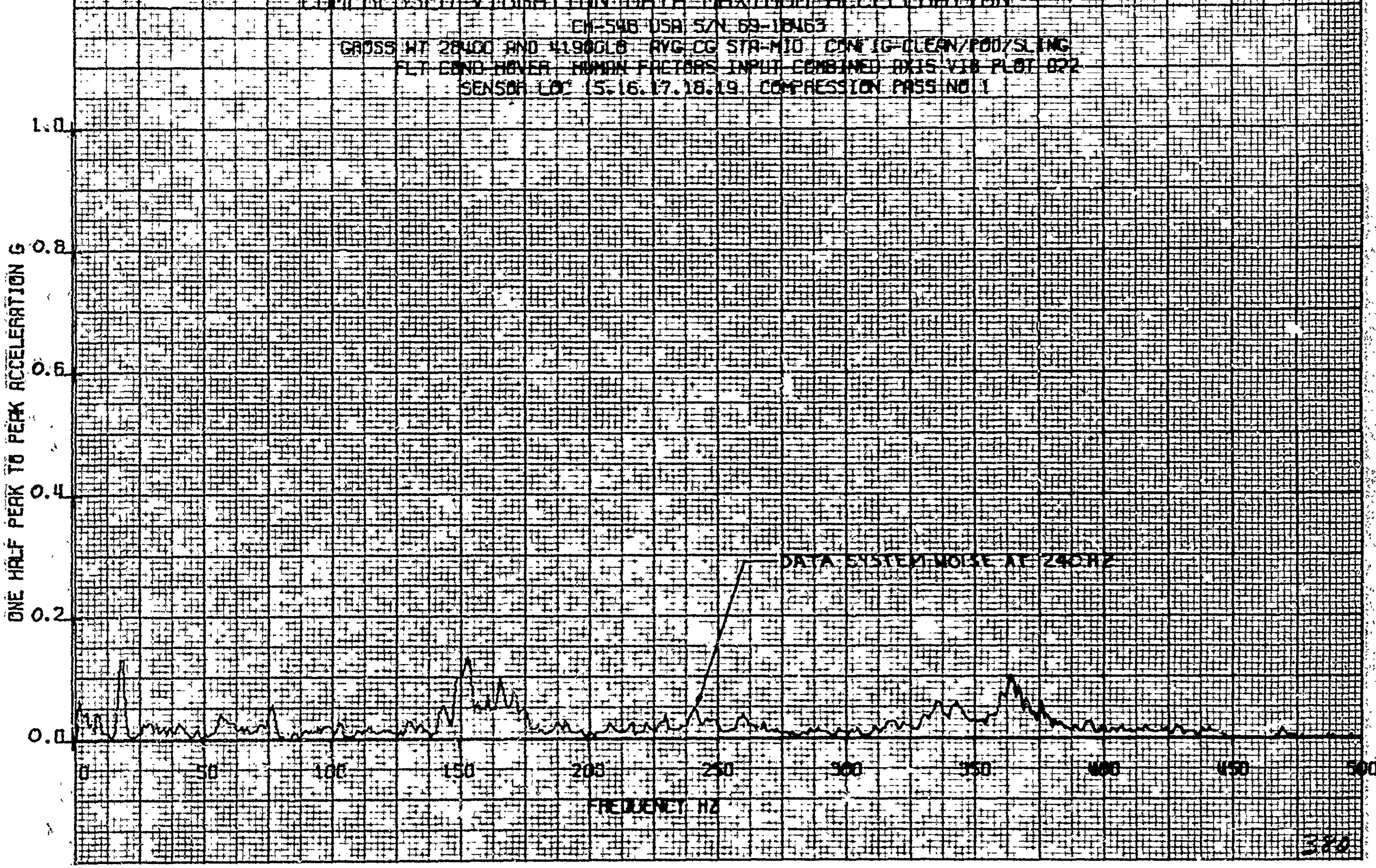


FIG 95
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND HOVER HUMAN FACTORS INPUT COMBINED AXIS VIB PLOT 022
SENSOR LOC 15.16.17.18.19 COMPRESSION PASS NO 1
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ
320

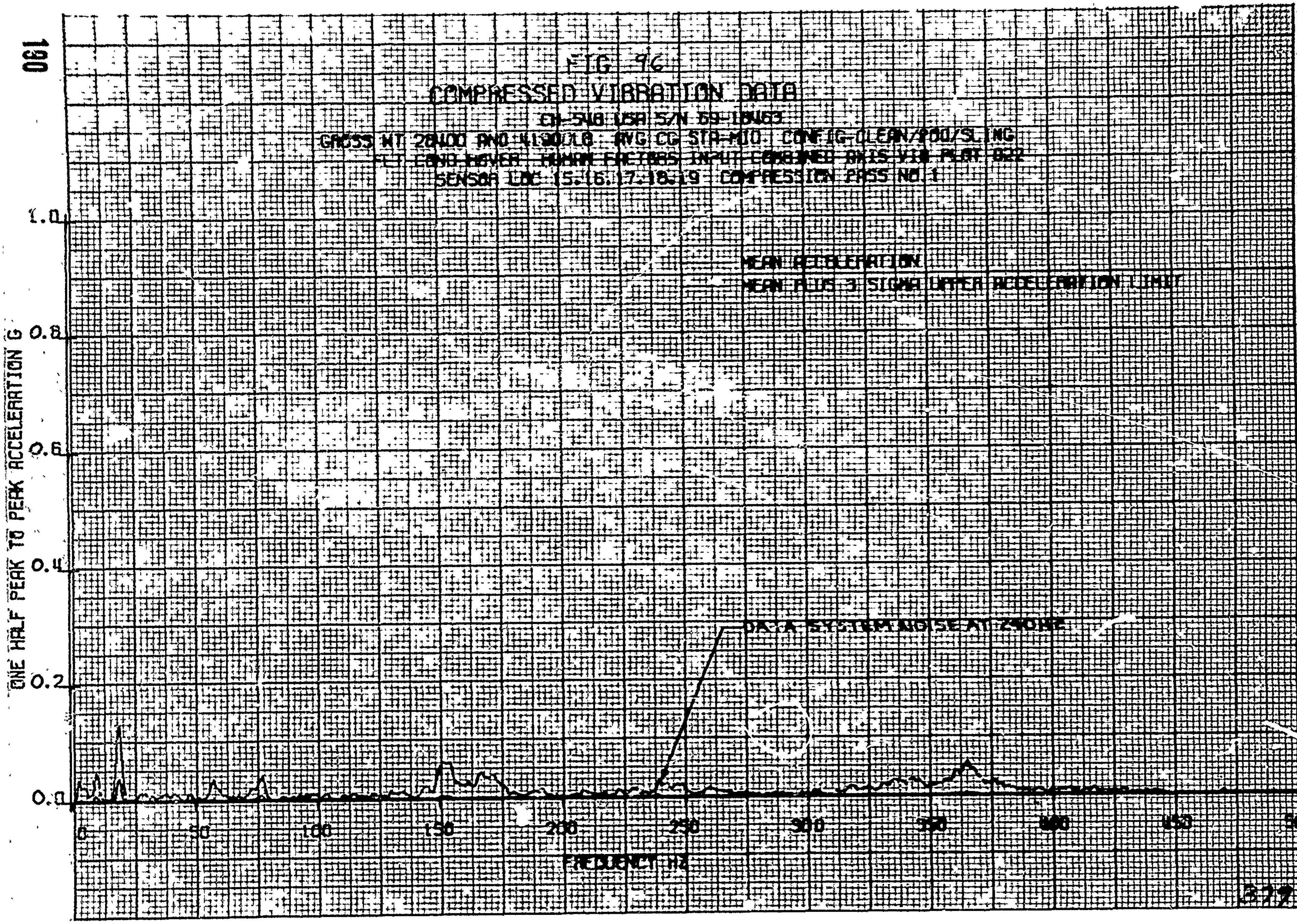


FIG 96
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 4190/LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-HOVER HUMAN FACTORS INPUT COMBINED AXIS VIB PLOT 022
SENSOR LOC 15,16,17,18,19 COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240HZ
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

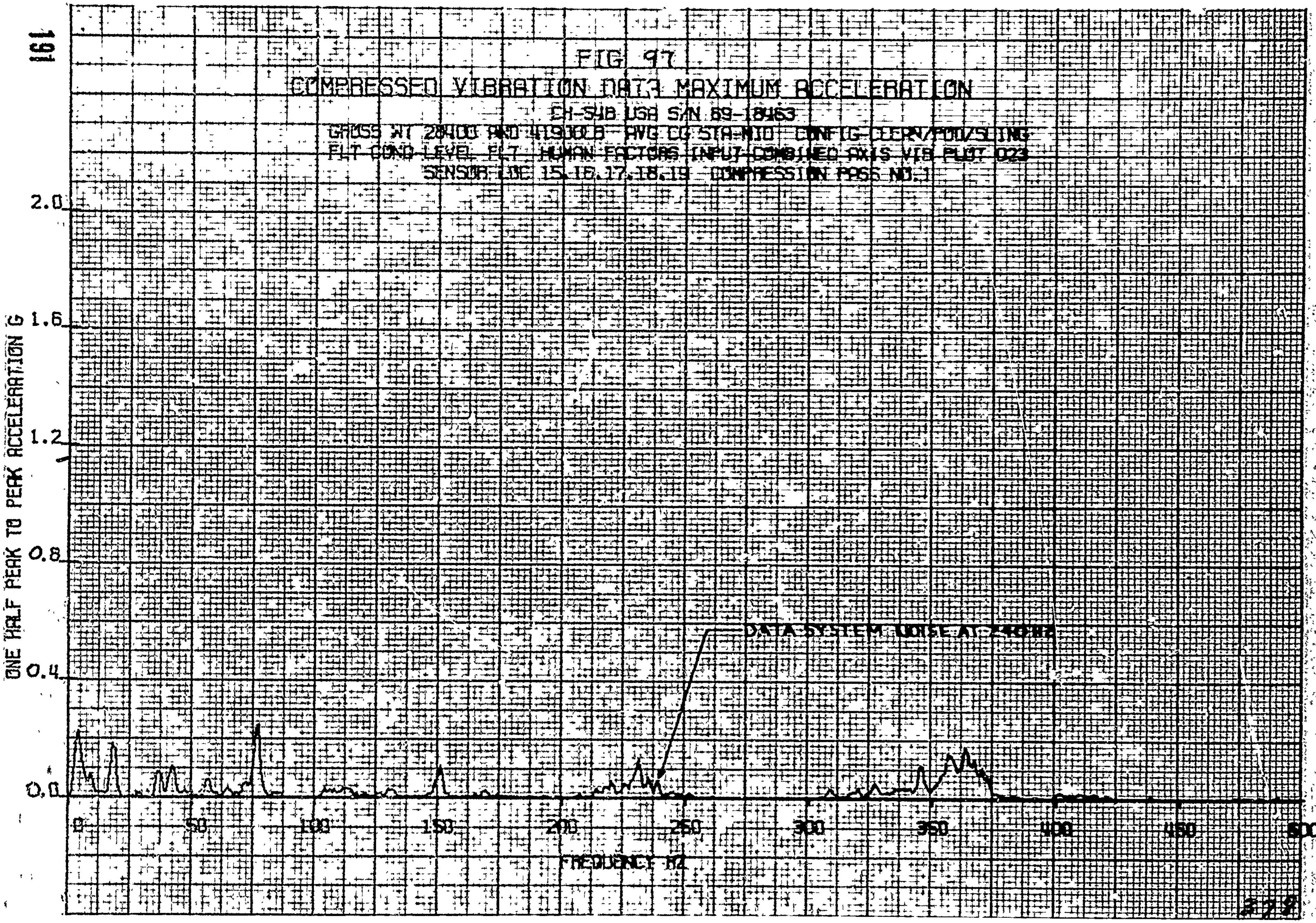


FIG 97
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND LEVEL FLT HUMAN FACTORS INPUT-COMBINED AXIS VIB PLOT 023
SENSOR LOC 15,16,17,18,19 COMPRESSION PASS NO.1

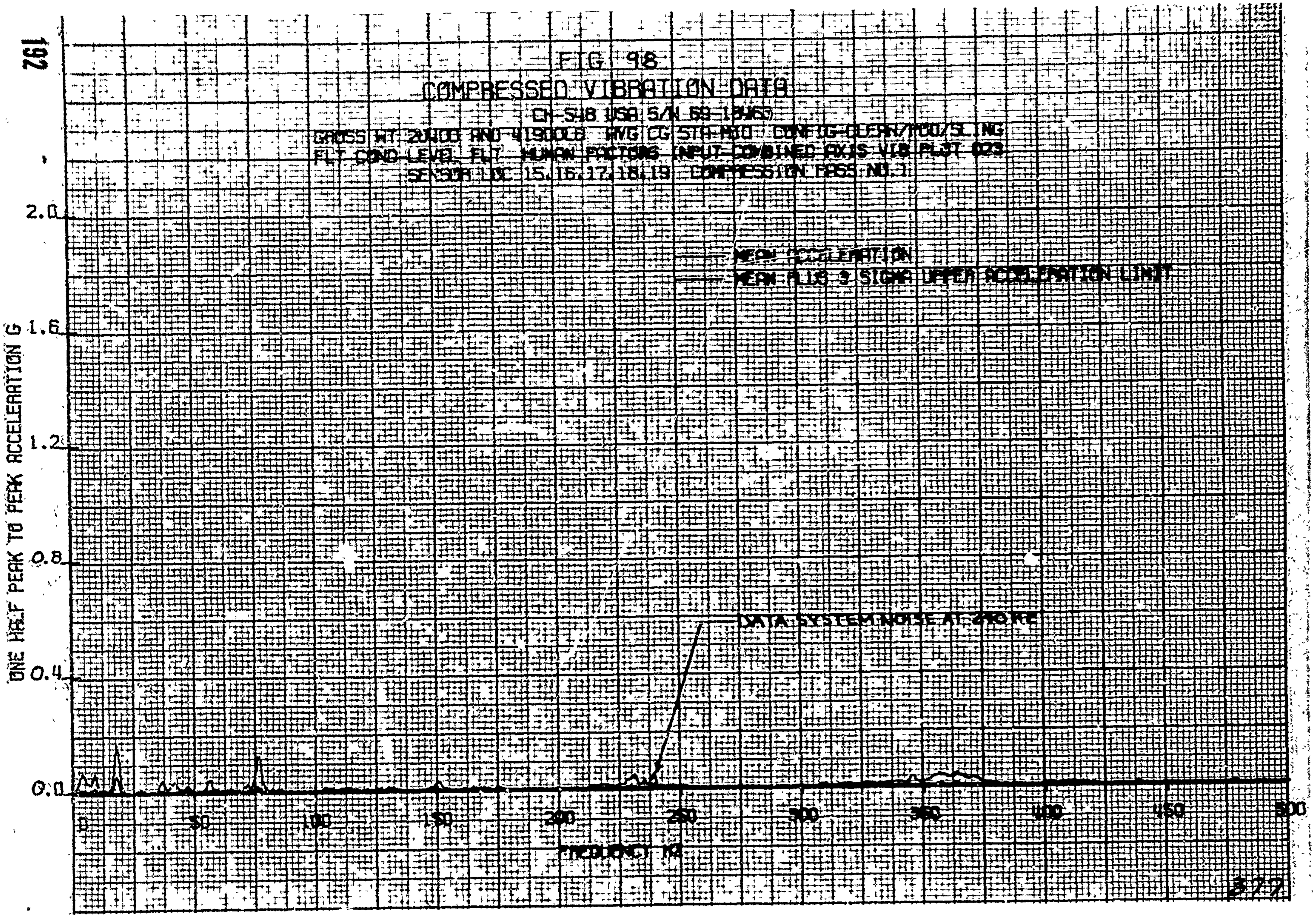


FIG 98
COMPRESSED VIBRATION DATA
CH-54B USA S/N 68-18467
GROSS WT 20400 AND 41900LB AVG CG STA 400 CONFIG-CLEAN/POD/SLING
FLT COND-LEVEL FLT HUMAN FACTORS INPUT-COMBINED AXIS VIB PLOT 023
SENSOR LOC 15,16,17,18,19 COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
2.0
1.6
1.2
0.8
0.4
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ
277

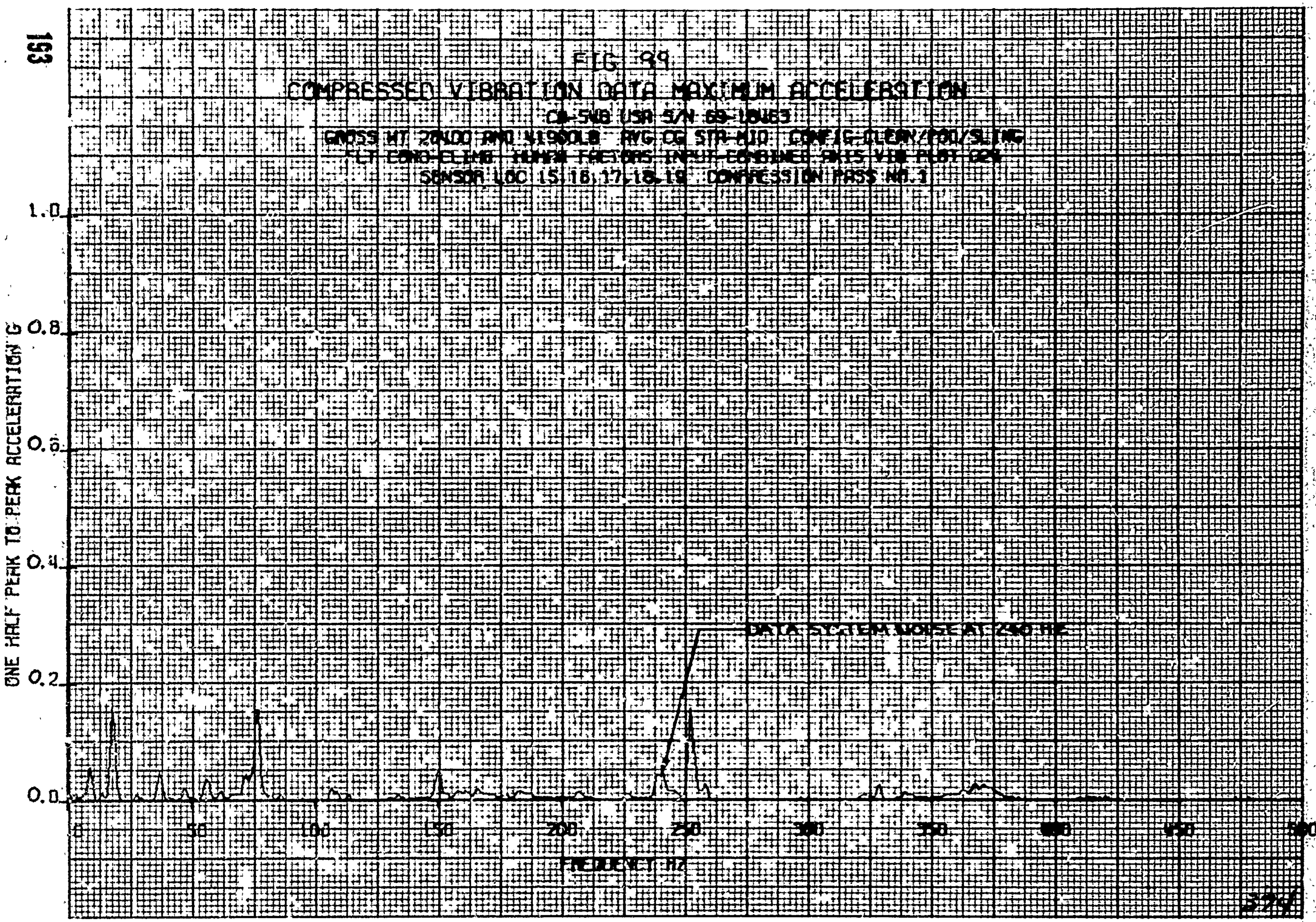


FIG. 99
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 20400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-CLIMB HUMAN FACTORS INPUT-COMBINED AXIS VIB PLOT G2W
SENSOR LOC 15,16,17,18,19 COMPRESSION PASS NO.1
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

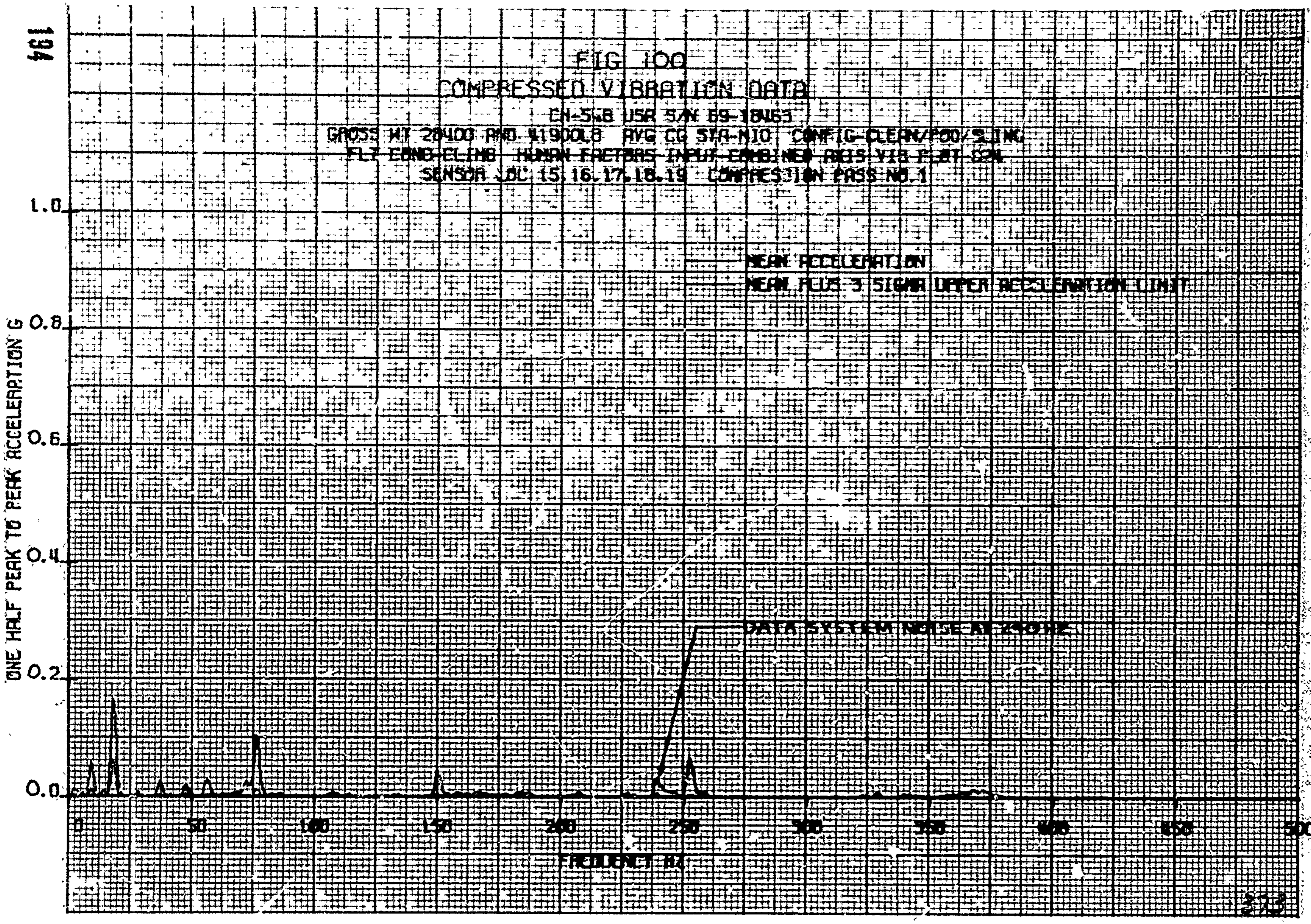


FIG 100
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-N10 CONFIG-CLEAN/POD/SLING
FLT COND-CLIMB HUMAN FACTORS INPUT COMBINED AXIS VIB PLOT SCAL
SENSOR LOC 15.16.17.18.19 COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 250 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

273

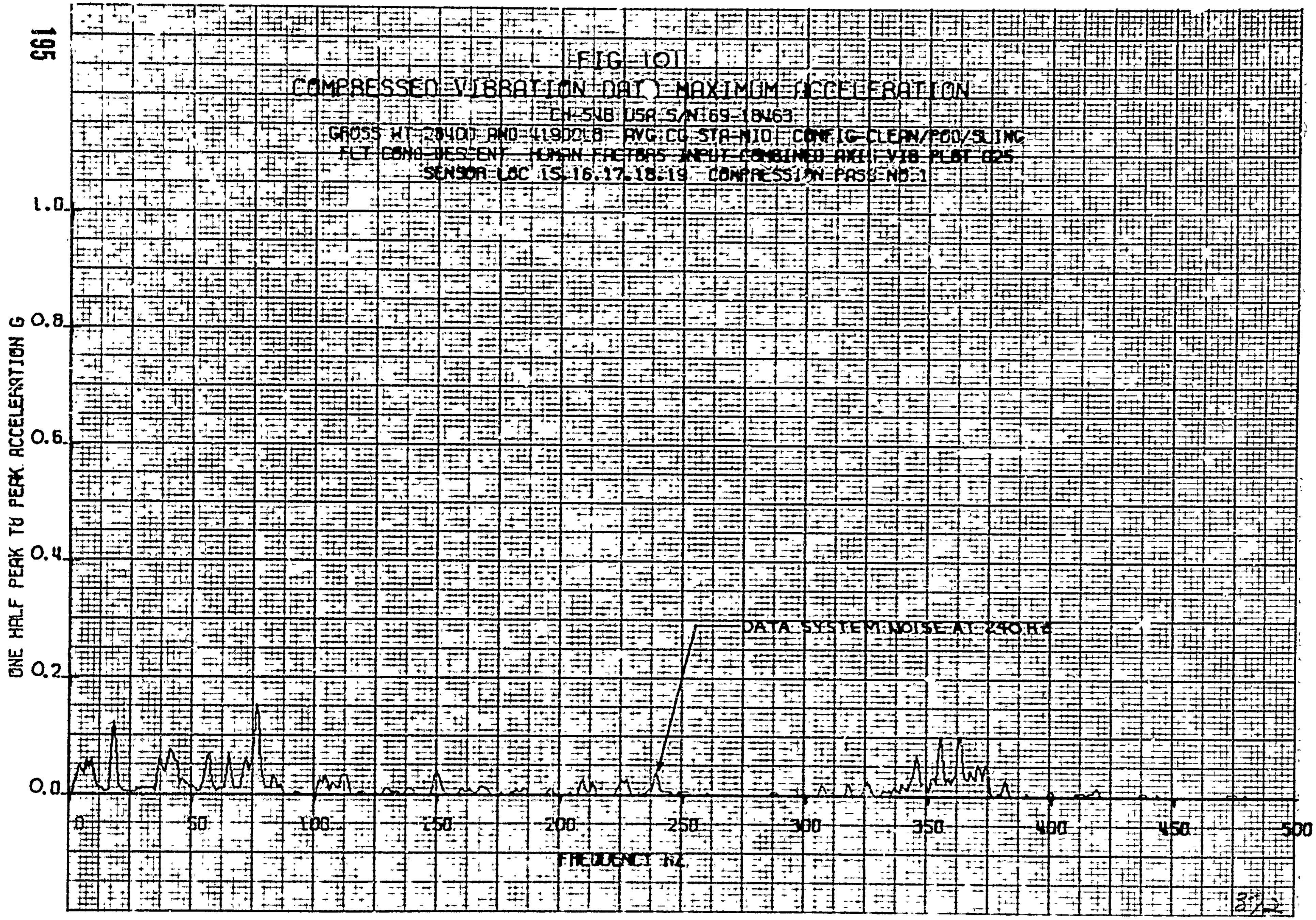


FIG 101
COMPRESSED VIBRATION DAT) MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 20400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND DESCENT HUMAN FACTORS INPUT COMBINED AXIS VIB PLOT 025
SENSOR LOC 15.16.17.18.19 COMPRESSION PASS NO 1
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

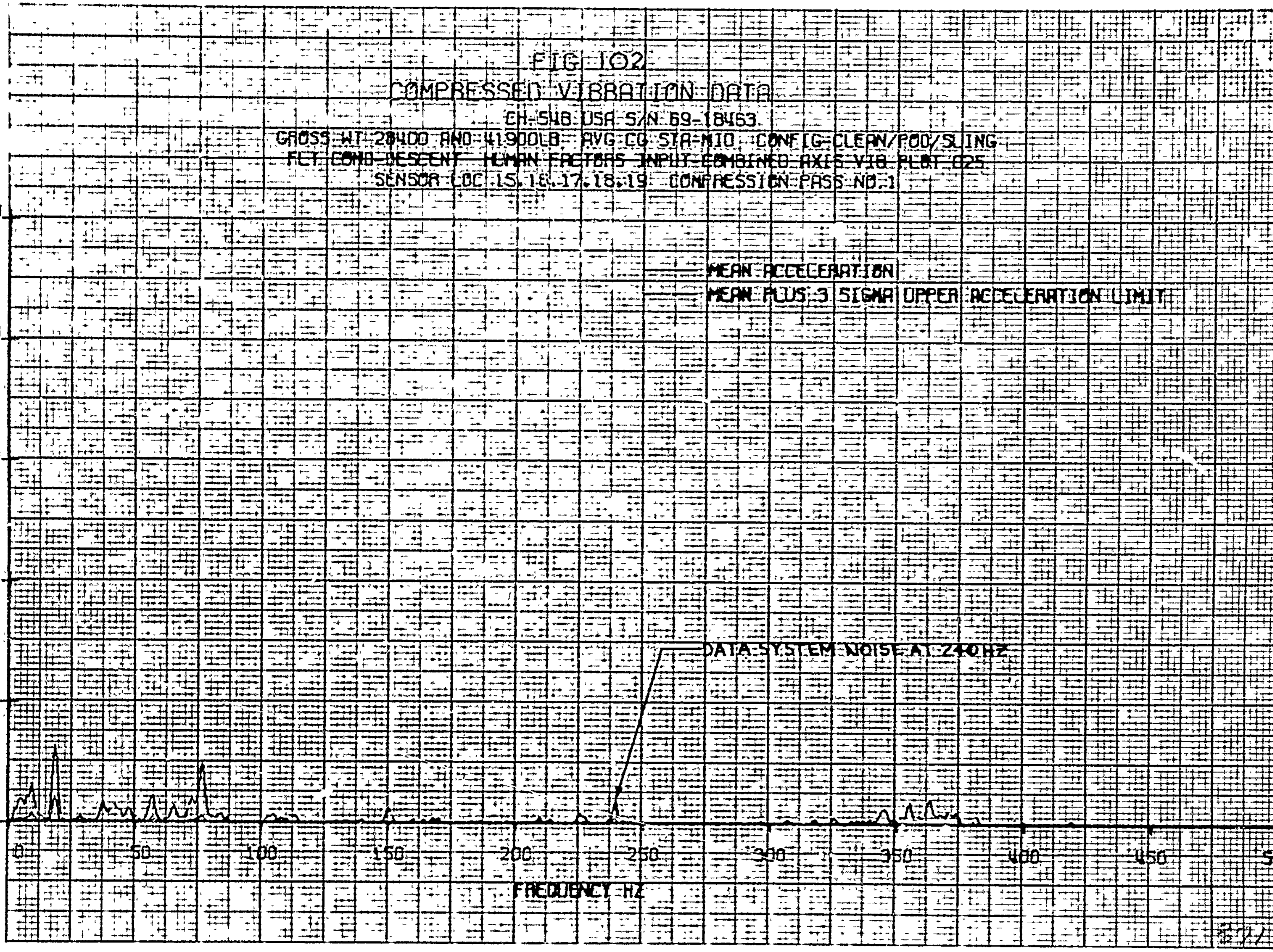


FIG 102
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MIO CONFIG-CLEAN/POD/SLING
FLT COND-DESCENT HUMAN FACTORS INPUT-COMBINED AXIS VIB PLOT 025
SENSOR LOC 15.16.17.18.19 COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240HZ
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

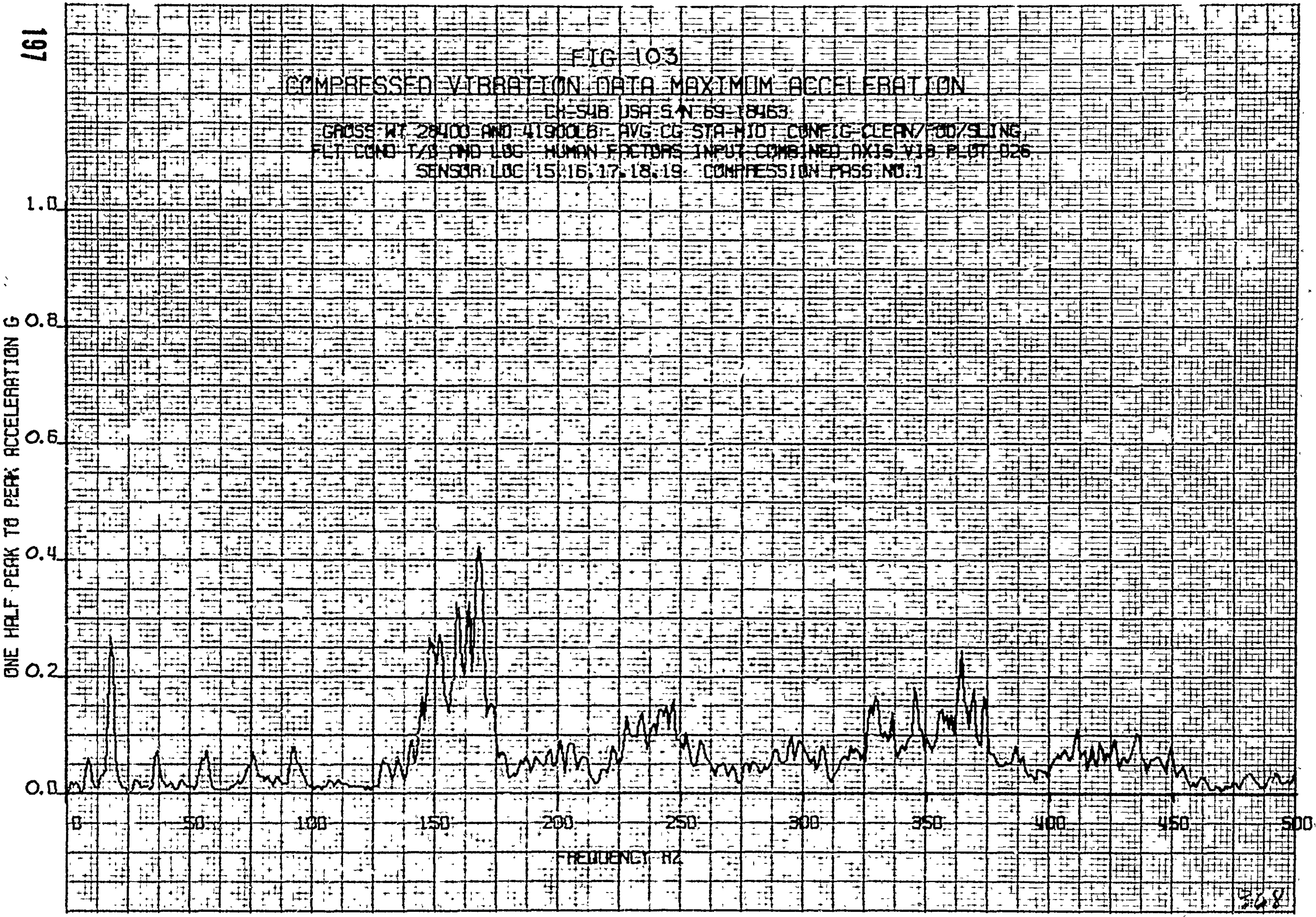


FIG 103
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG CLEAN/ OD/SLING
FLT COND T/S AND LOC HUMAN FACTORS INPUT COMBINED AXIS VIB PLOT 026
SENSOR LOC 15,16,17,18,19 COMPRESSION PASS NO.1
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

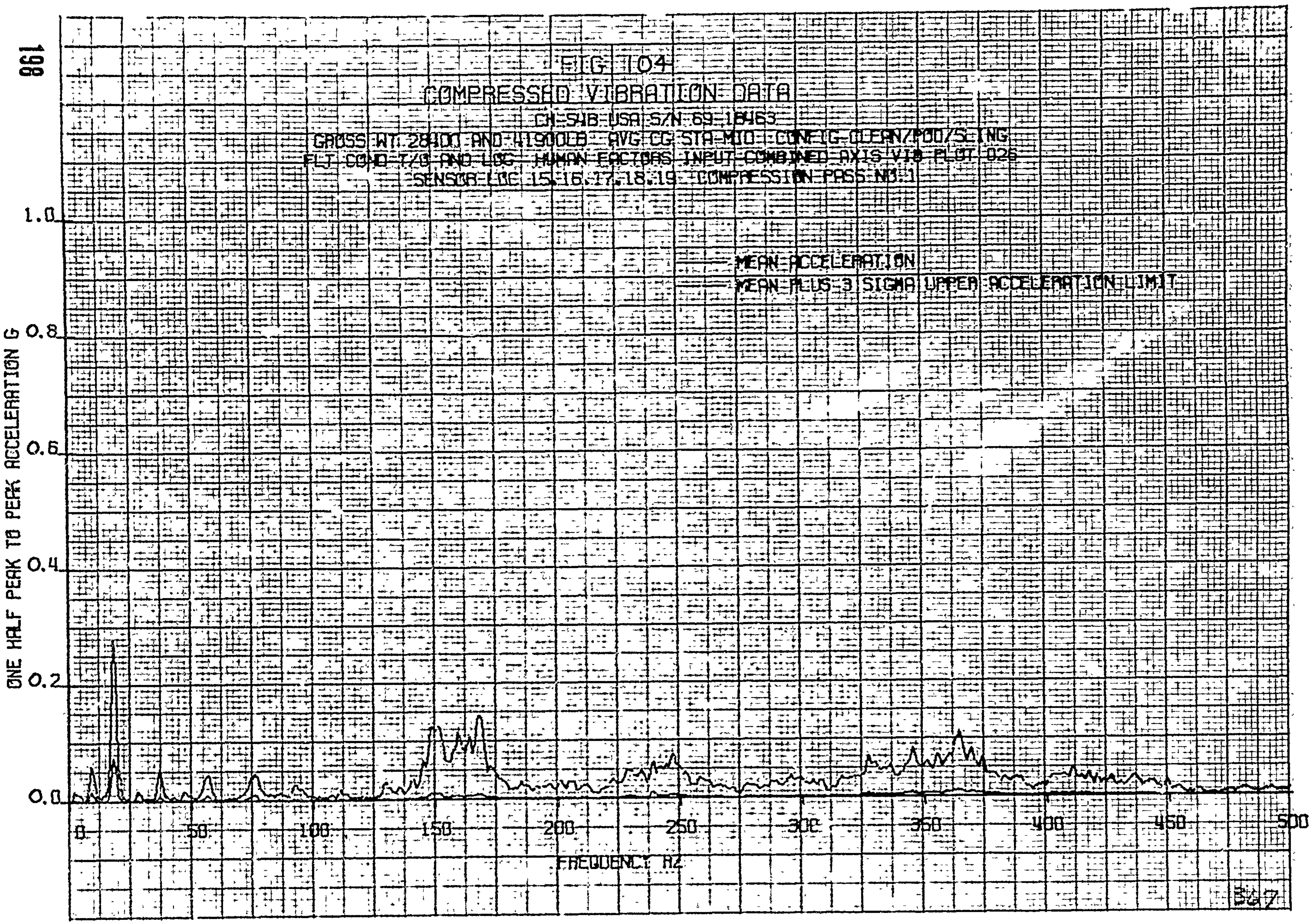
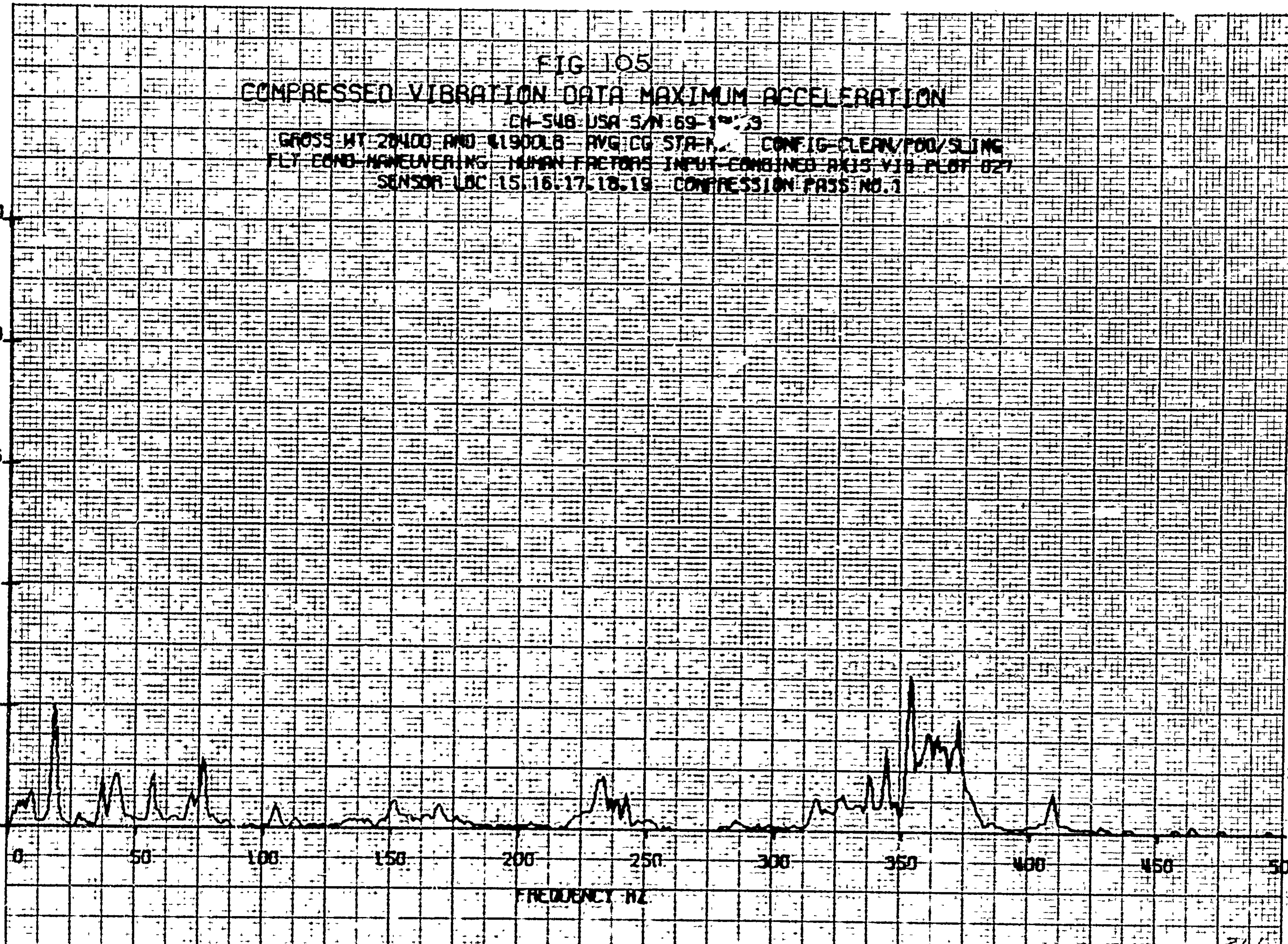


FIG 104
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND T/O AND LDG HUMAN FACTORS INPUT COMBINED AXIS VIB PLOT 026
SENSOR LOC 15.16.17.18.19 COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
1.0
0.8
0.6
0.4
0.2
0.0
ONE HALF PEAK TO PEAK ACCELERATION G
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ
367

FIG 105

COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION



366

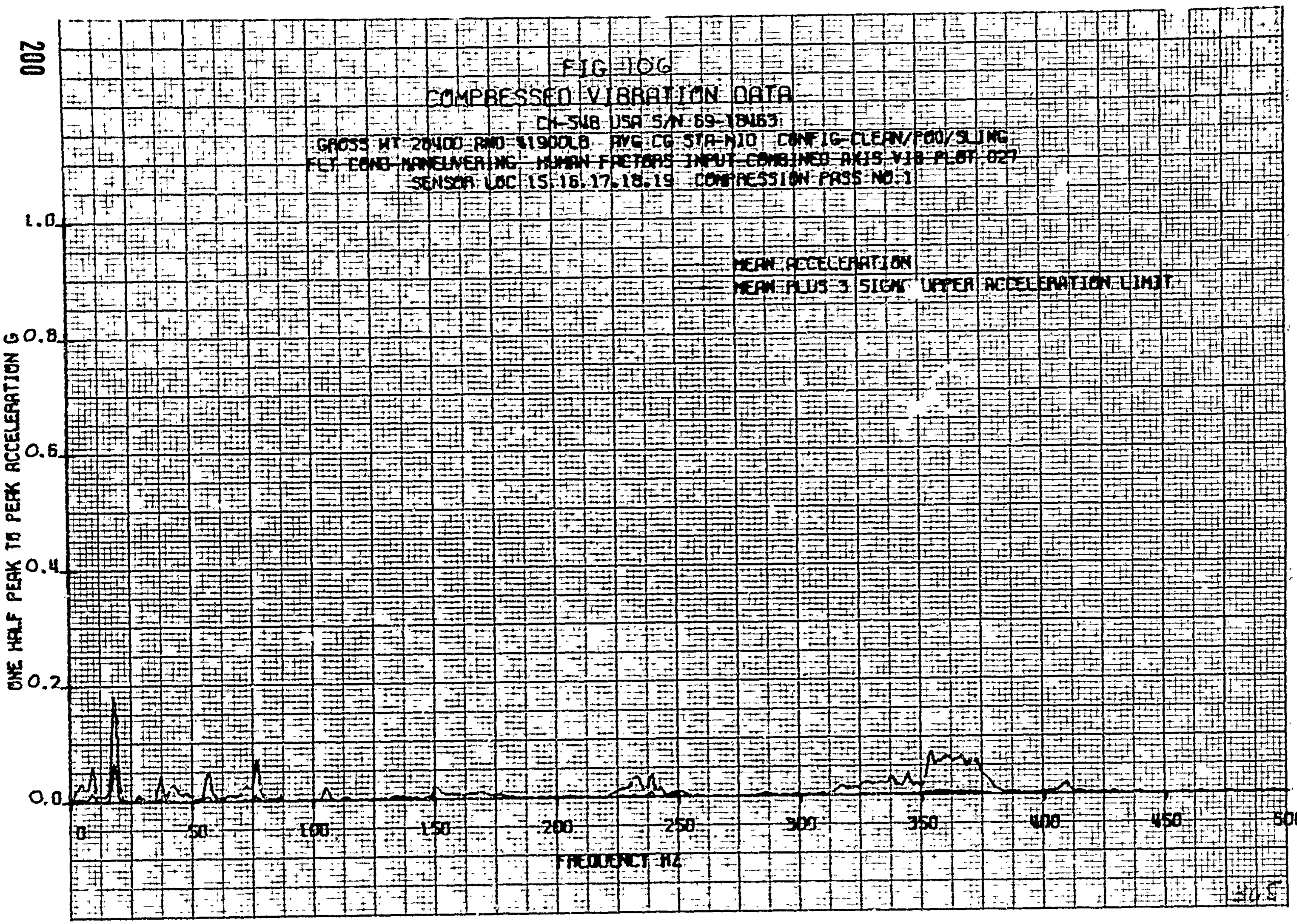


FIG 10G
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 20400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-MANEUVERING HUMAN FACTORS INPUT-COMBINED AXIS VIB PLOT 027
SENSOR LOC 15.16.17.18.19 COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

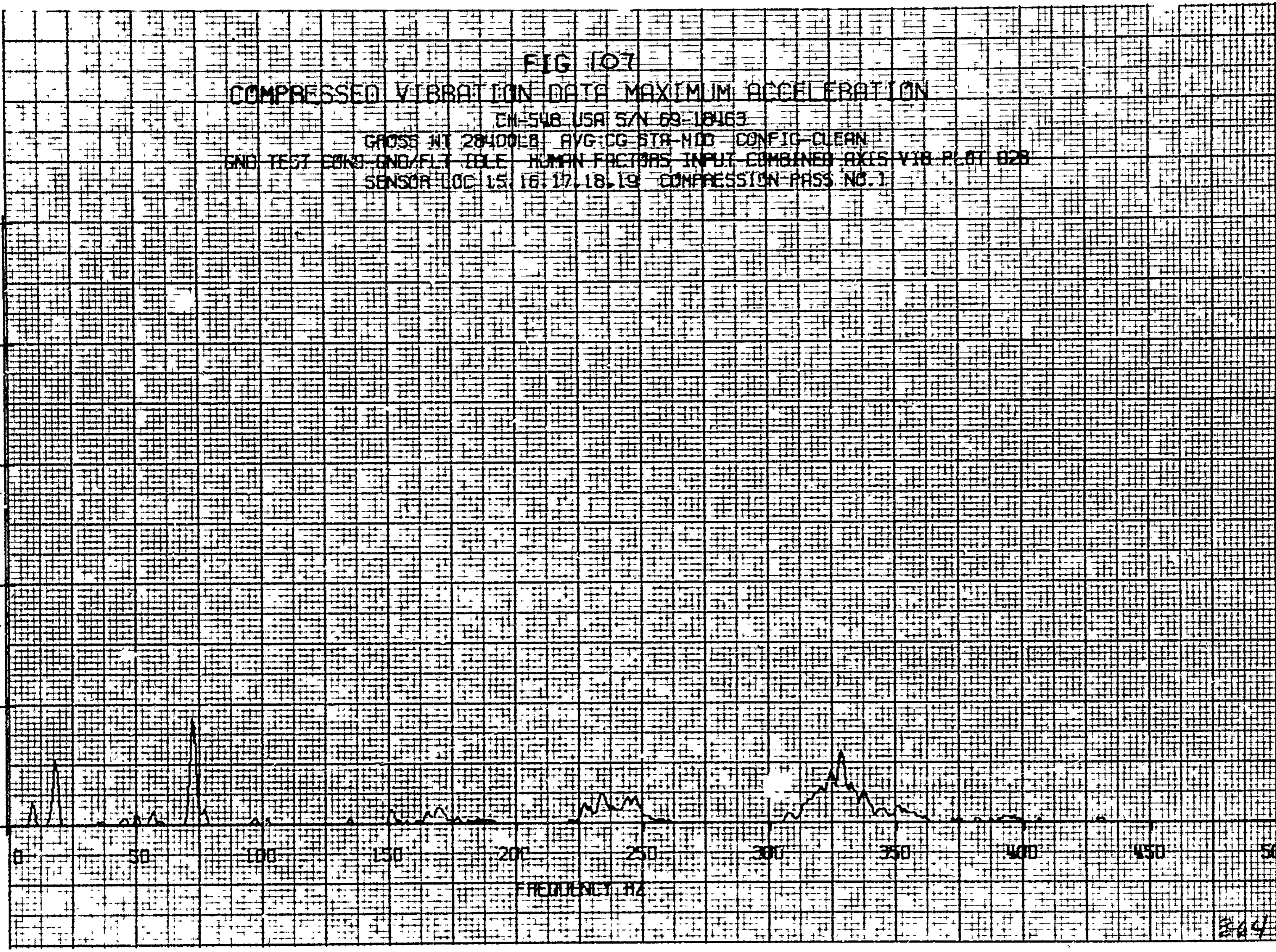


FIG 107
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400LB AVG CG STA-MID CONFIG-CLEAN
GND TEST COND-GND/FLT IDLE HUMAN FACTORS INPUT COMBINED AXIS VIB PLOT 028
SENSOR LOC 15.16.17.18.19 COMPRESSION PASS NO.1
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

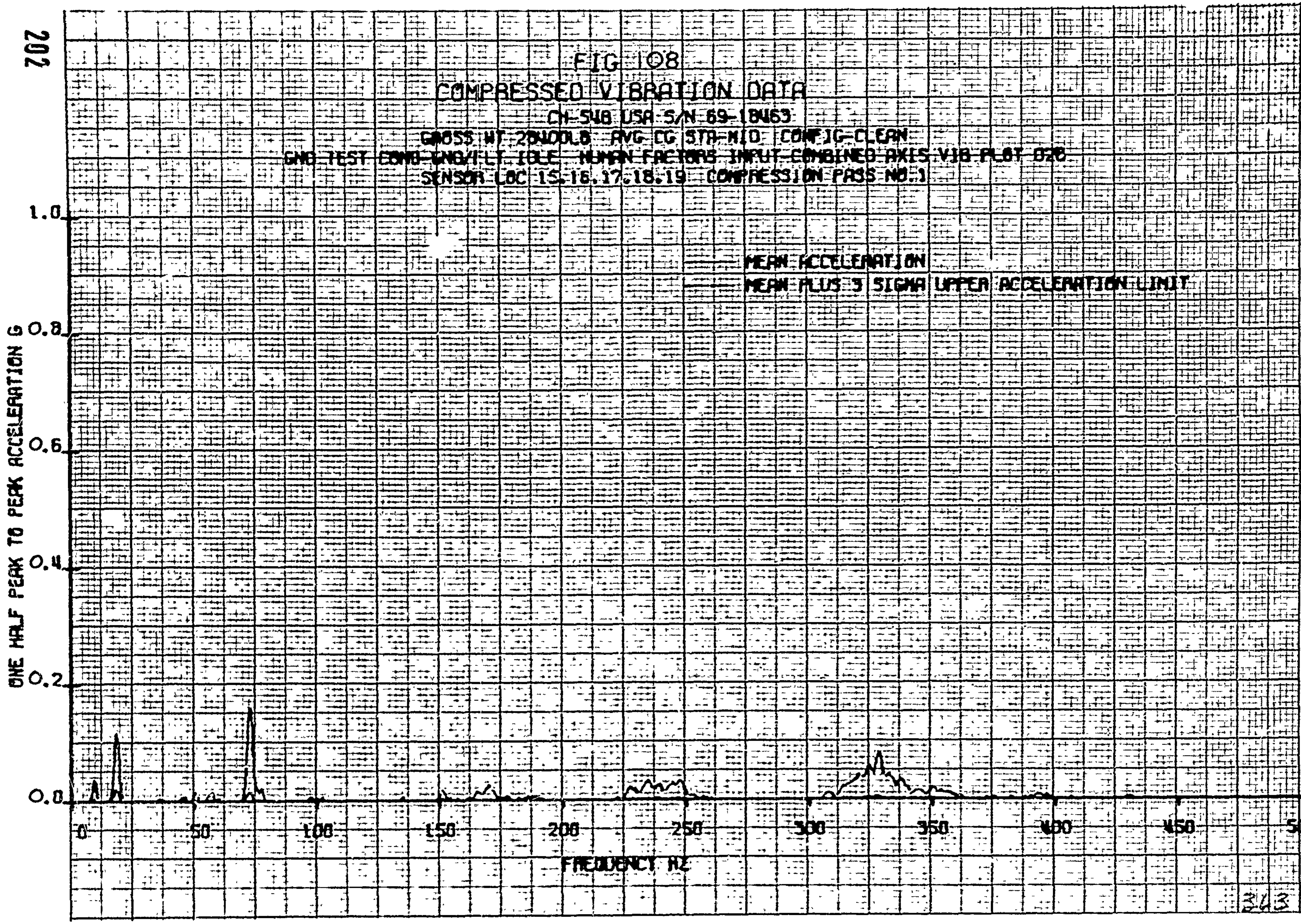


FIG 108
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400LB AVG CG STA-MID CONFIG-CLEAN
GND TEST COND-GND/FLT IDLE HUMAN FACTORS INPUT-COMBINED AXIS VIB PLOT 020
SENSOR LOC 15.16.17.18.19 COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ
343

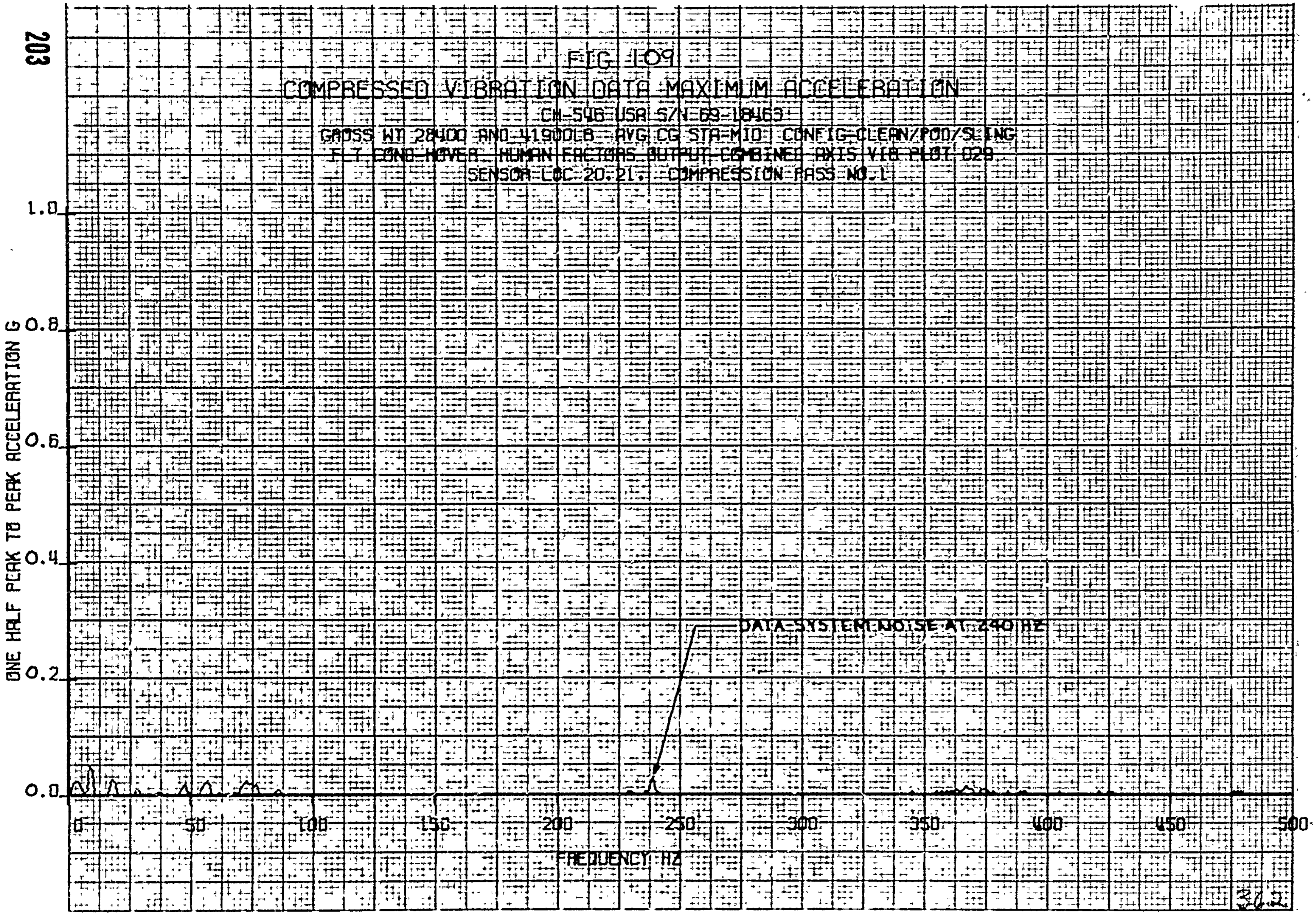


FIG 109
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-HOVER HUMAN FACTORS OUTPUT COMBINED AXIS VIB PLOT 028
SENSOR LOC 20.21. COMPRESSION PASS NO.1
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

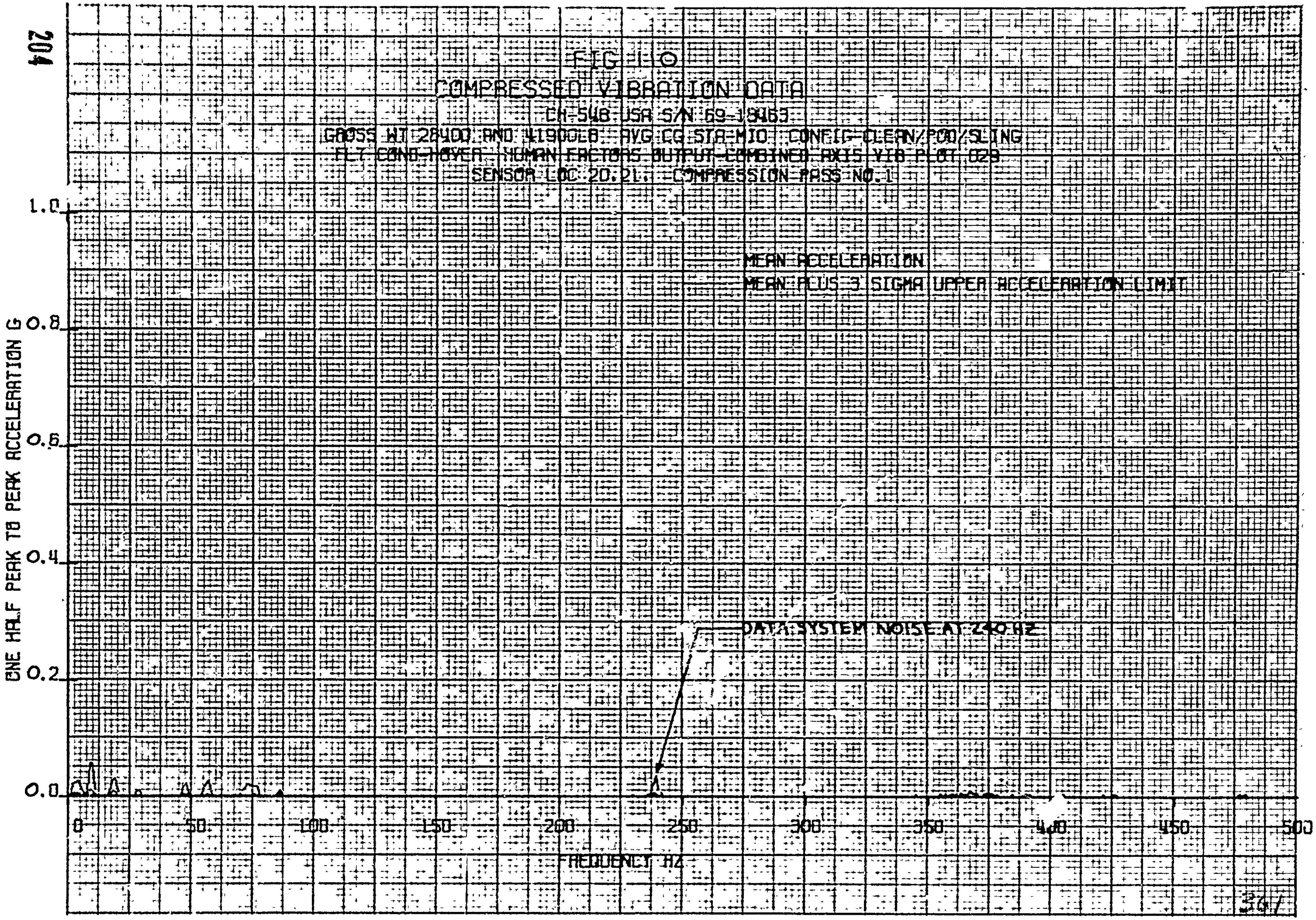


FIG 110
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-HOVER HUMAN FACTORS OUTPUT-COMBINED AXIS VIB PLOT 028
SENSOR LOC 20,21, COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ
367

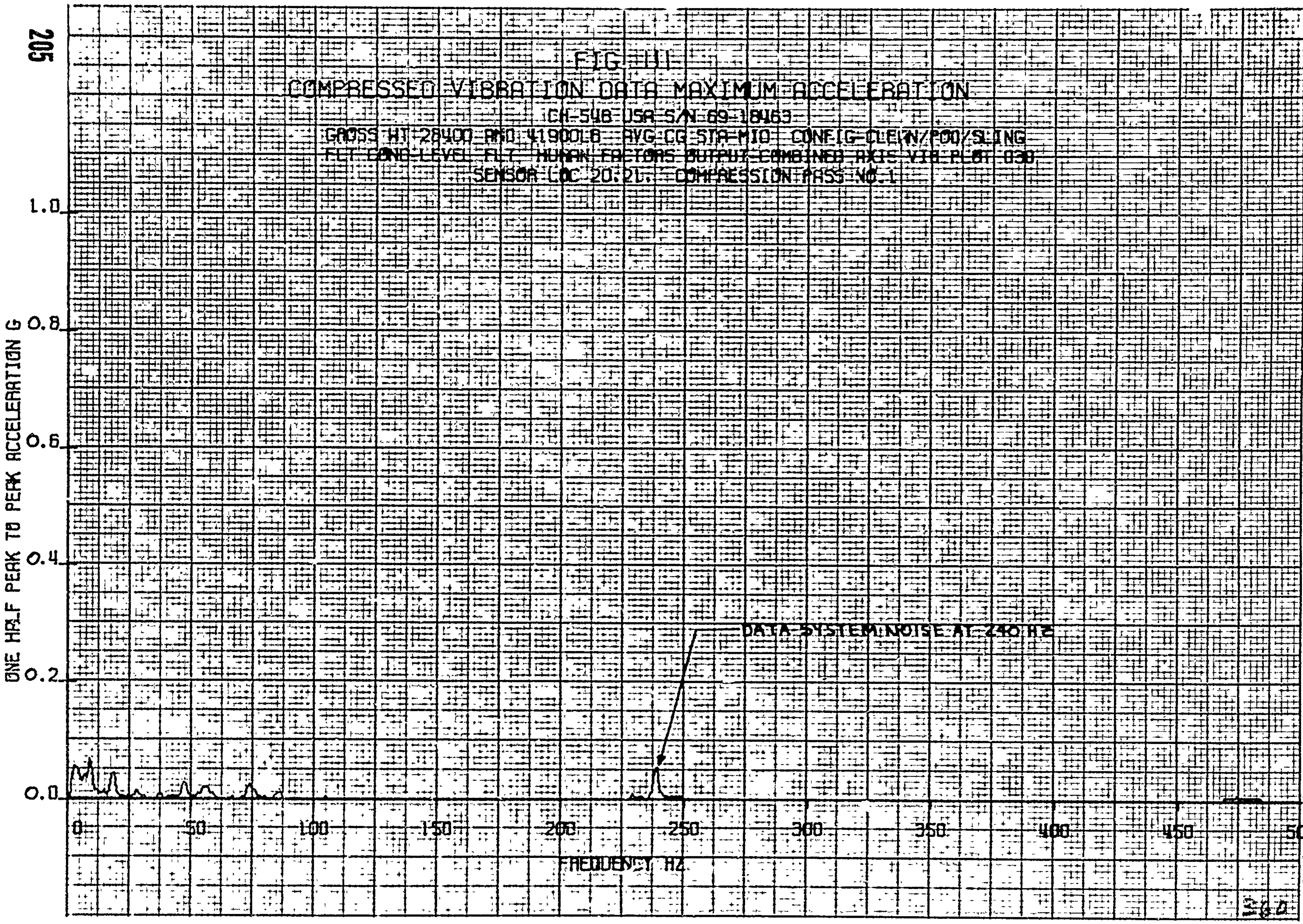


FIG 111
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-LEVEL FLT HUMAN FACTORS OUTPUT COMBINED AXIS VIB PLOT 030
SENSOR LOC 20.21. COMPRESSION PASS NO.1
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

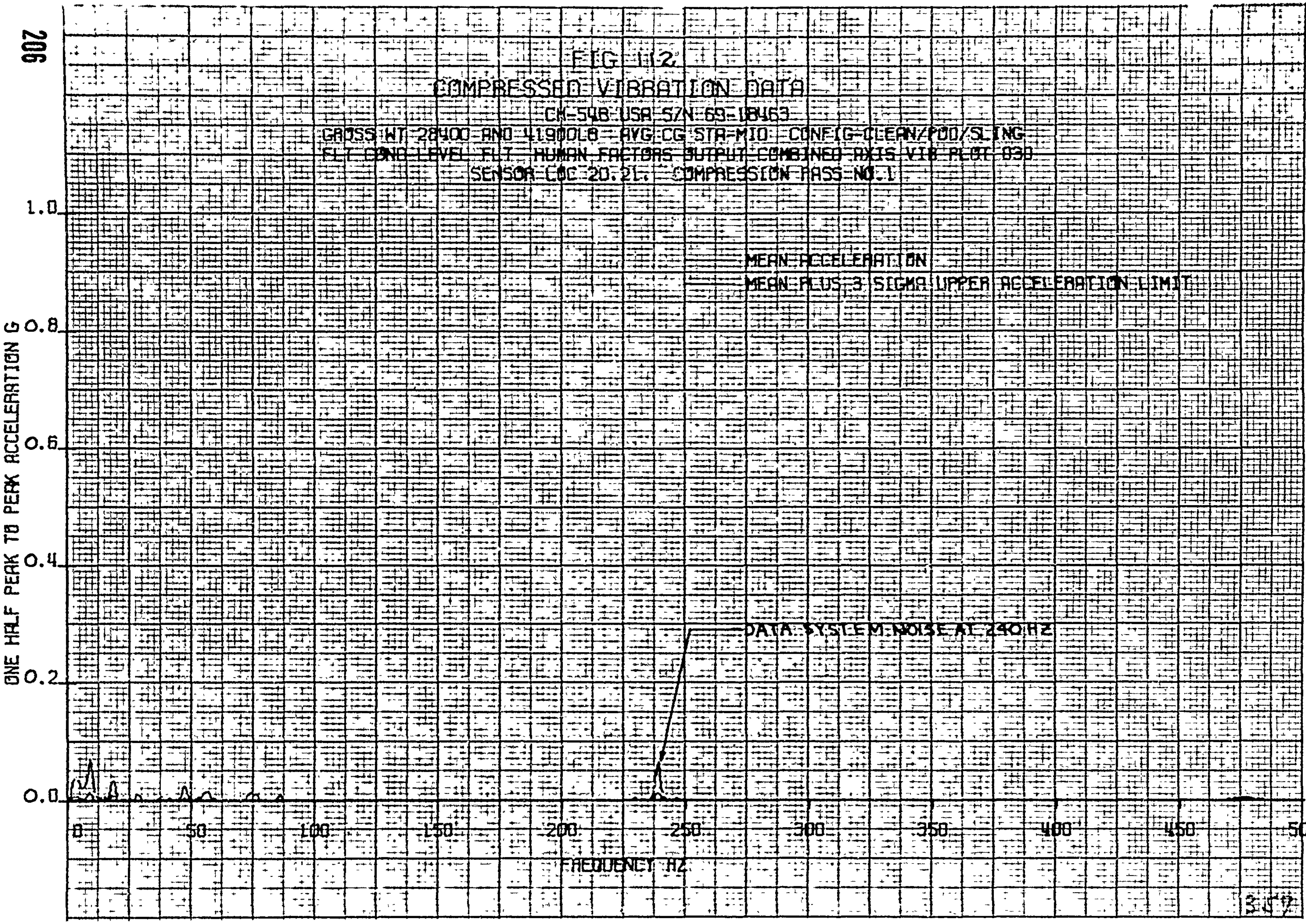


FIG 112
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND-LEVEL FLT HUMAN FACTORS OUTPUT COMBINED AXIS VIB PLOT 030
SENSOR LOC 20.21. COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

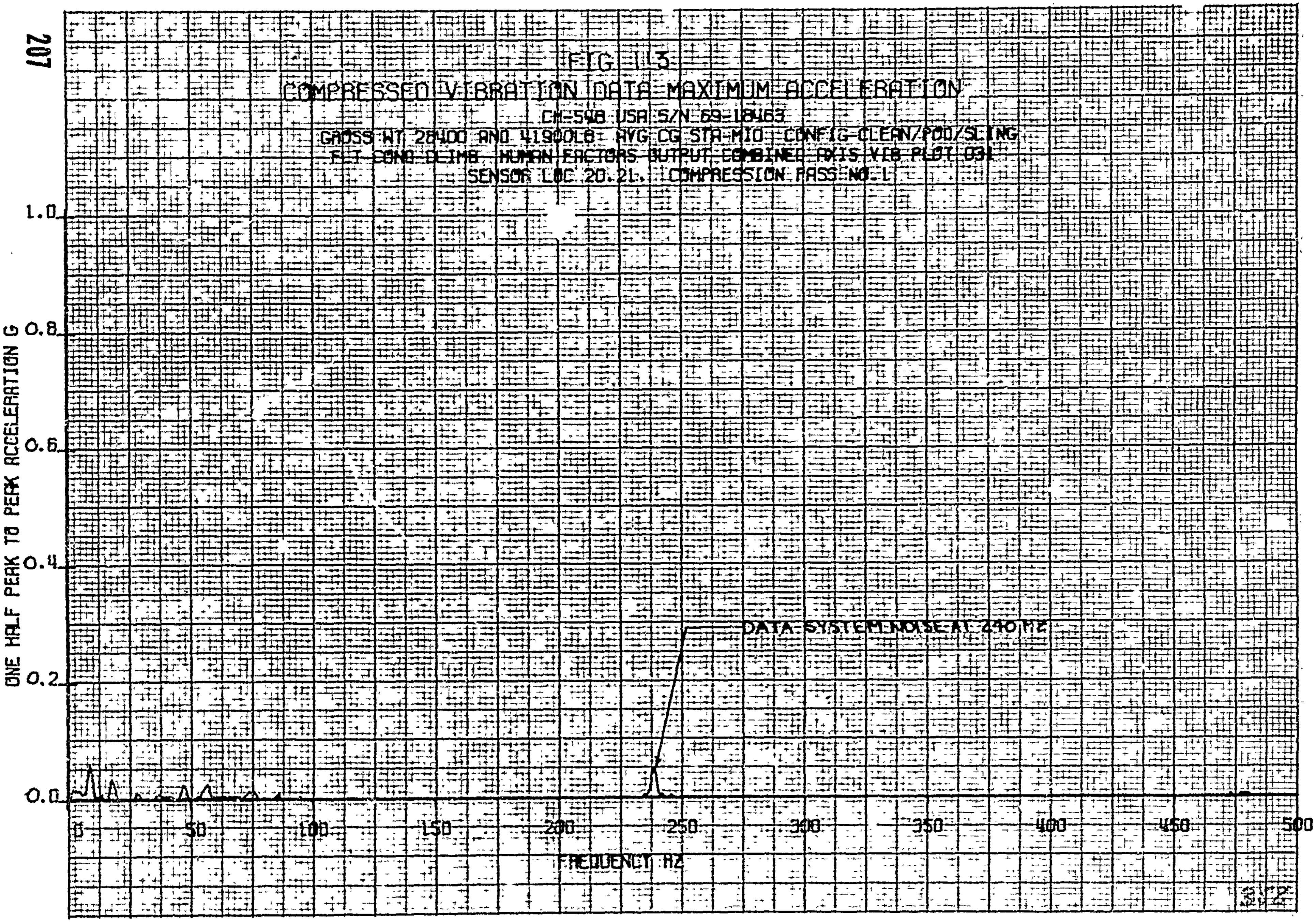


FIG 113
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND CLIMB HUMAN FACTORS OUTPUT COMBINED AXIS VIB PLOT 031
SENSOR LOC 20.21. COMPRESSION PASS NO.1
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

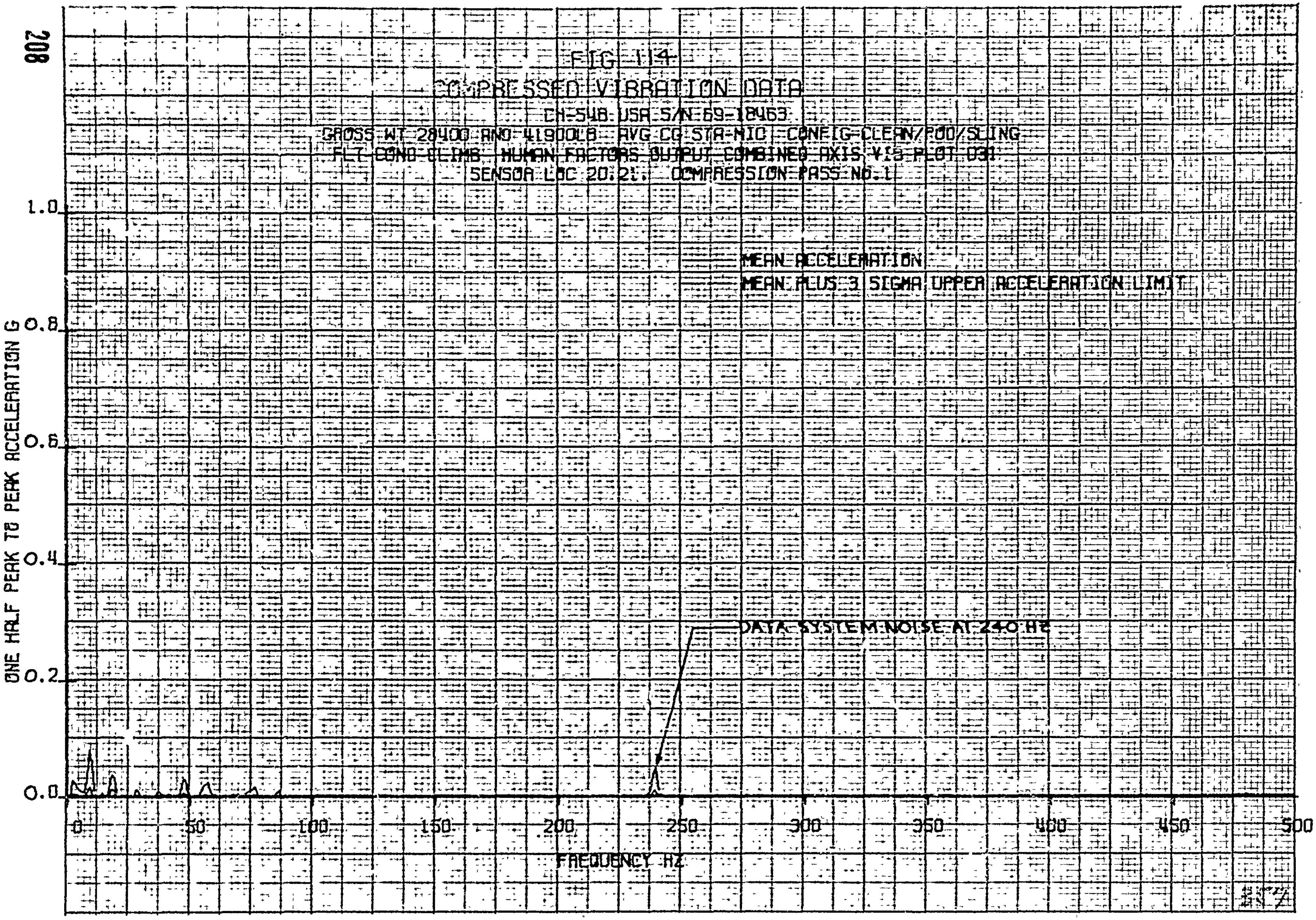


FIG 114
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND CLIMB HUMAN FACTORS OUTPUT COMBINED AXIS VIB PLOT 031
SENSOR LOC 20.21. COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
0.0
0.2
0.4
0.6
0.8
1.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

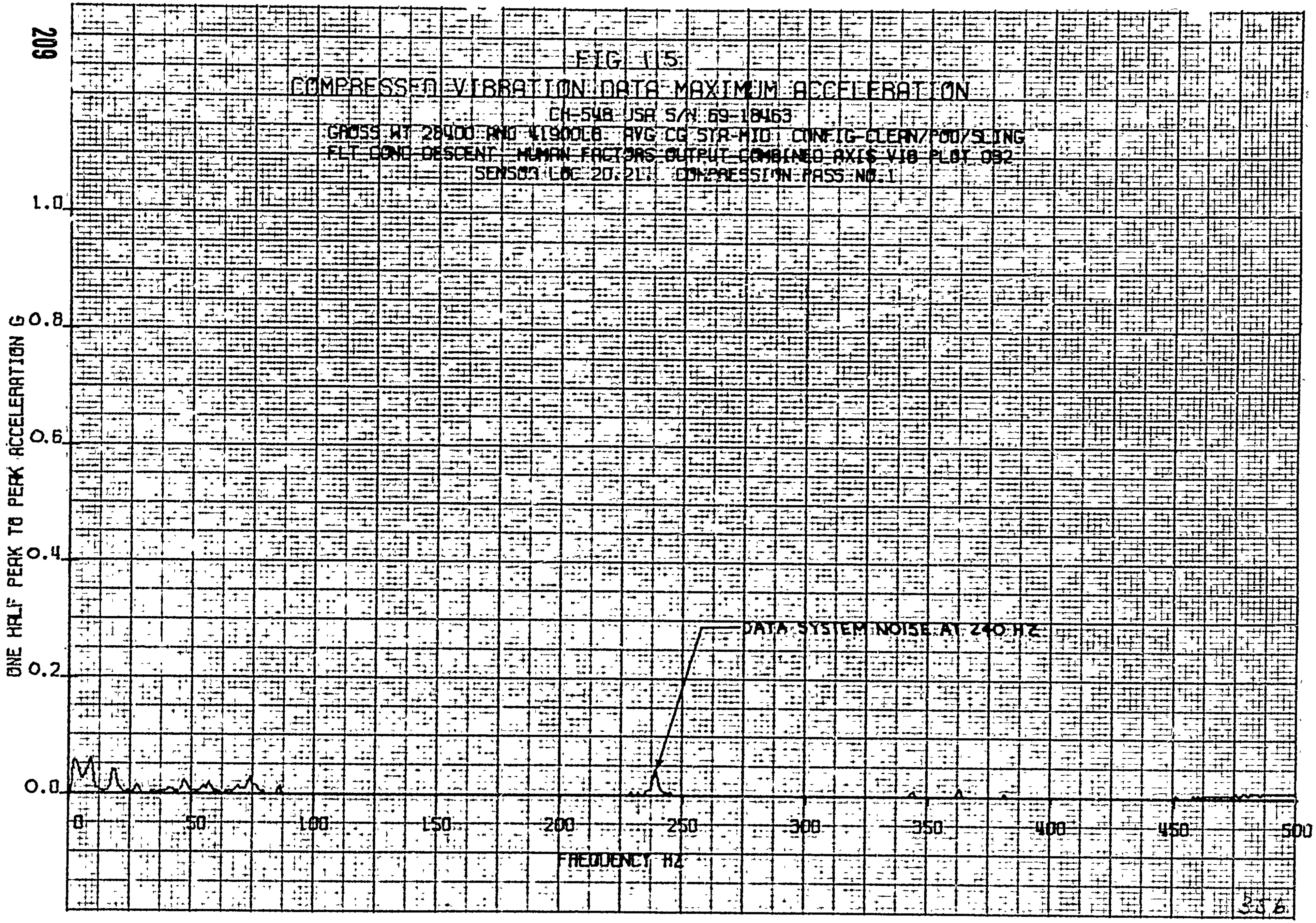


FIG 115
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND DESCENT HUMAN FACTORS OUTPUT COMBINED AXIS VIB PLOT 092
SENSOR LOC 20.21 COMPRESSION PASS NO.1
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
DATA SYSTEM NOISE AT 240 HZ
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ
336

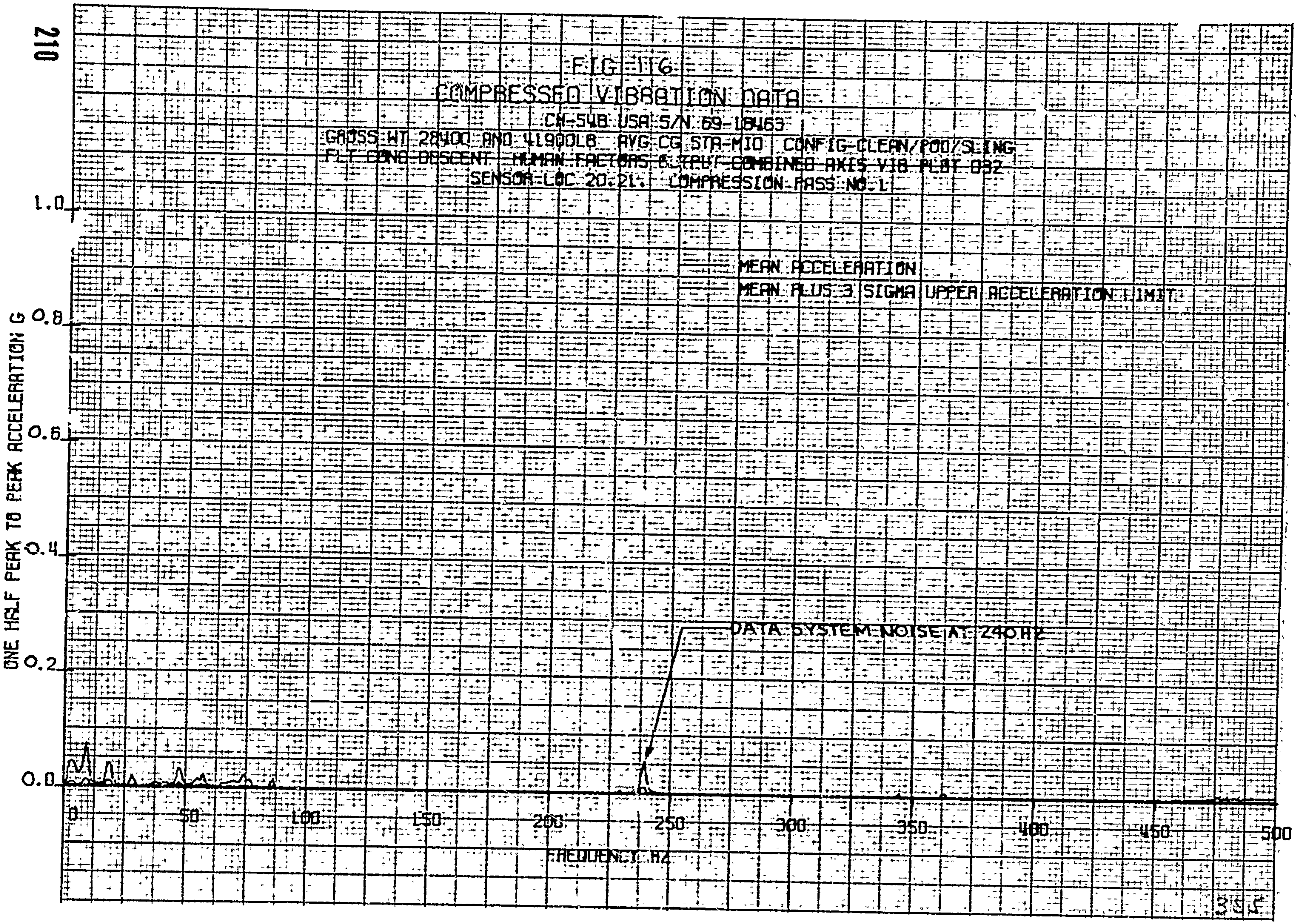


FIG 116
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND DESCENT HUMAN FACTORS & TPLF COMBINED AXIS VIB PLOT 032
SENSOR LOC 20.21. COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

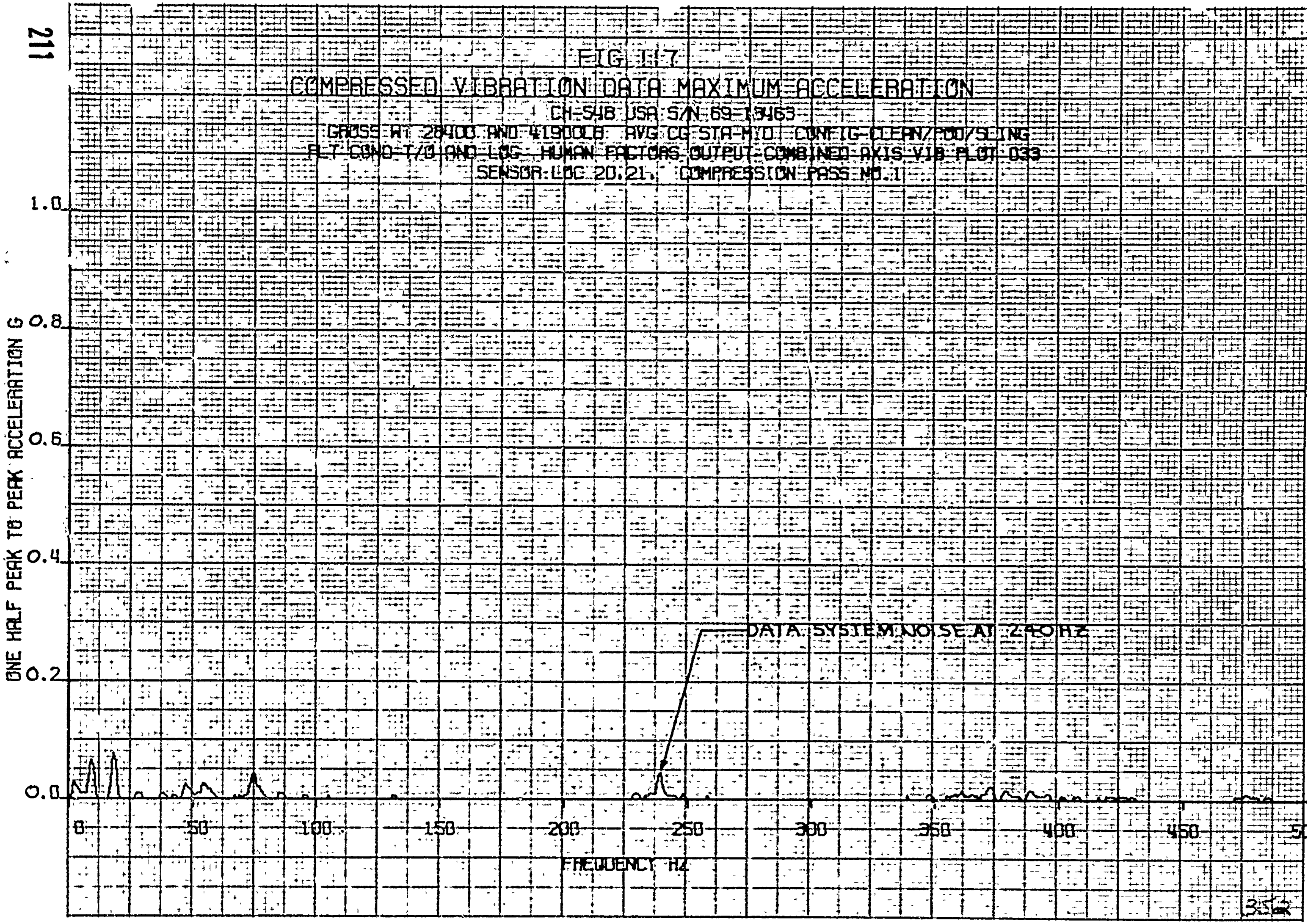


FIG 11.7
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-H/D CONFIG-CLEAN/POD/SLING
FLT COND-T/O AND LDG HUMAN FACTORS OUTPUT-COMBINED AXIS VIB PLOT 033
SENSOR LOC 20,21, COMPRESSION PASS NO.1

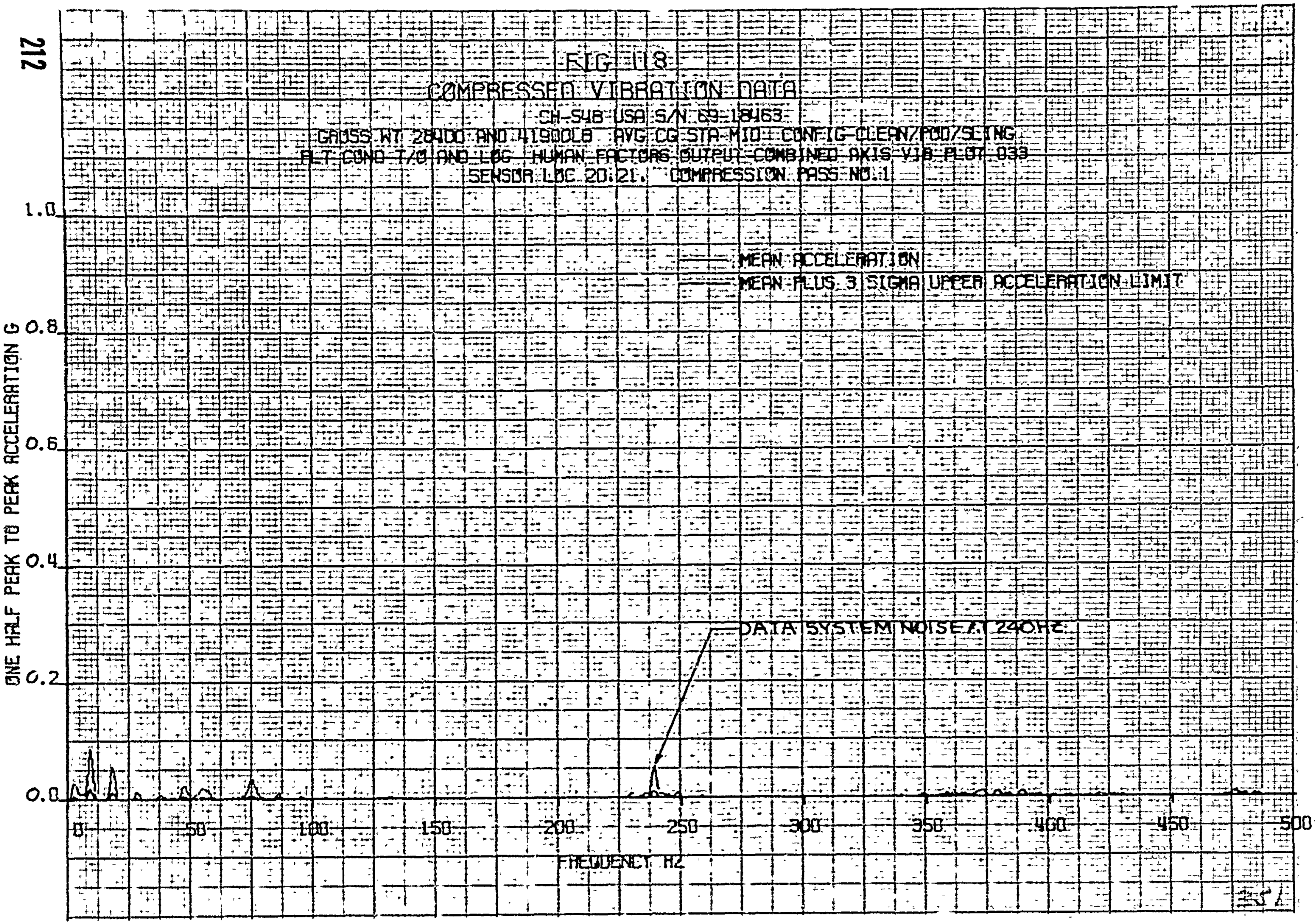


FIG 118
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA MID CONFIG CLEAN/POD/SLING
FLT COND T/O AND LOC HUMAN FACTORS OUTPUT COMBINED AXIS VIB PLOT 033
SENSOR LOC 20.21. COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240HZ
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

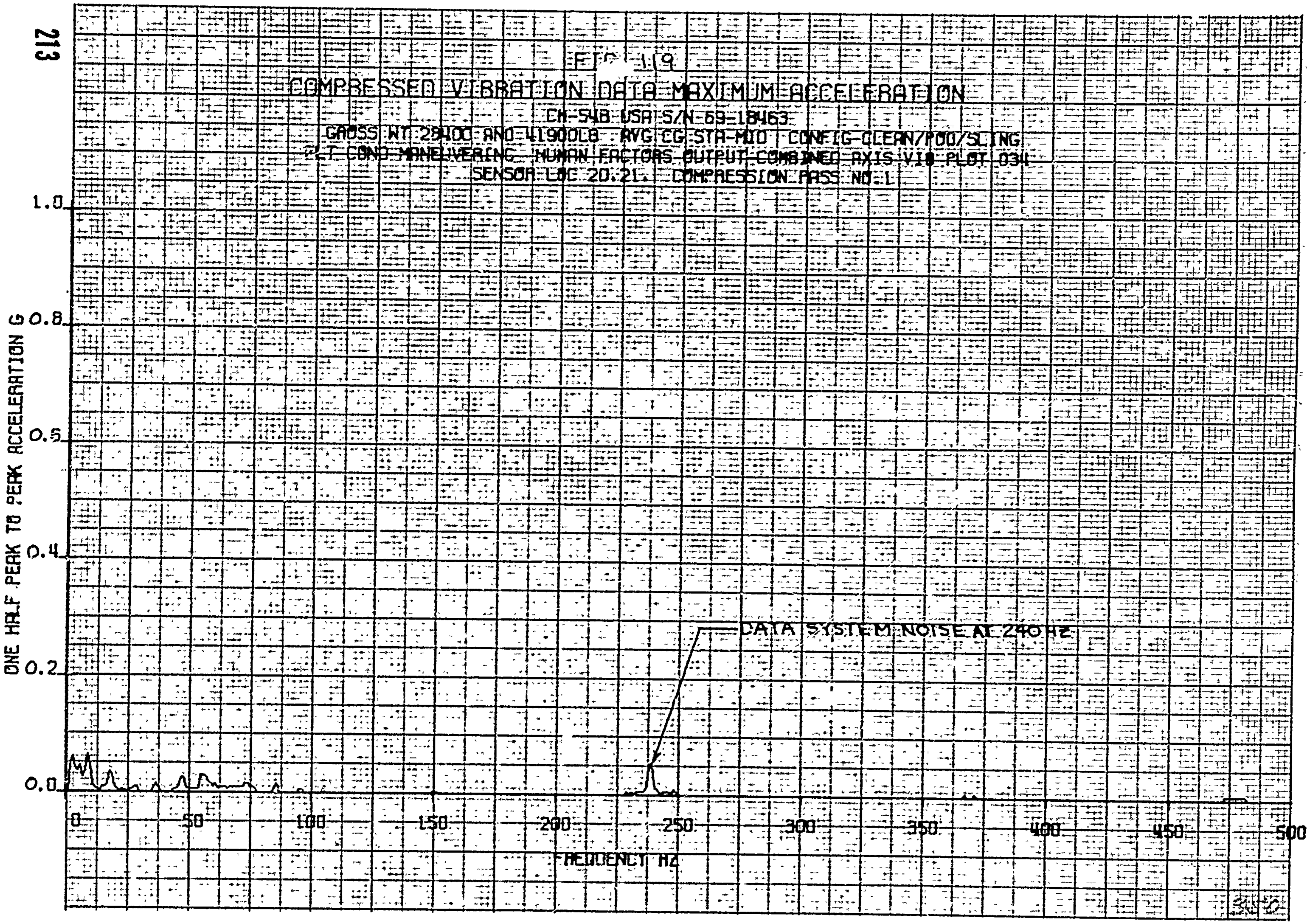


FIG. 119
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND MANEUVERING HUMAN FACTORS OUTPUT COMBINED AXIS VIB PLOT 034
SENSOR LOC 20.21. COMPRESSION PASS NO.1
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

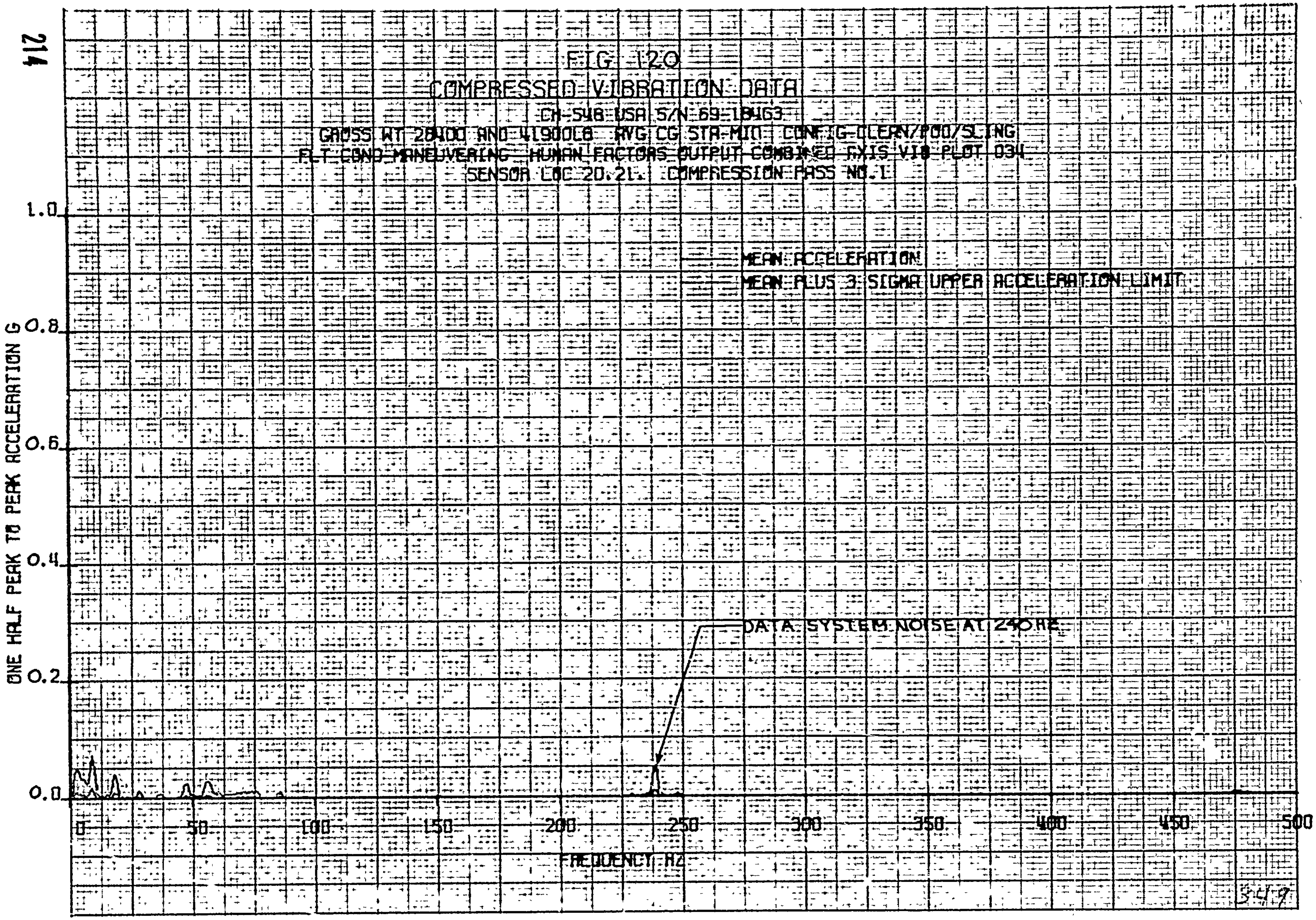


FIG 120
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400 AND 41900LB AVG CG STA-MID CONFIG-CLEAN/POD/SLING
FLT COND MANEUVERING HUMAN FACTORS OUTPUT COMBINED AXIS VIB PLOT 034
SENSOR LOC 20.21. COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240HZ
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ
349

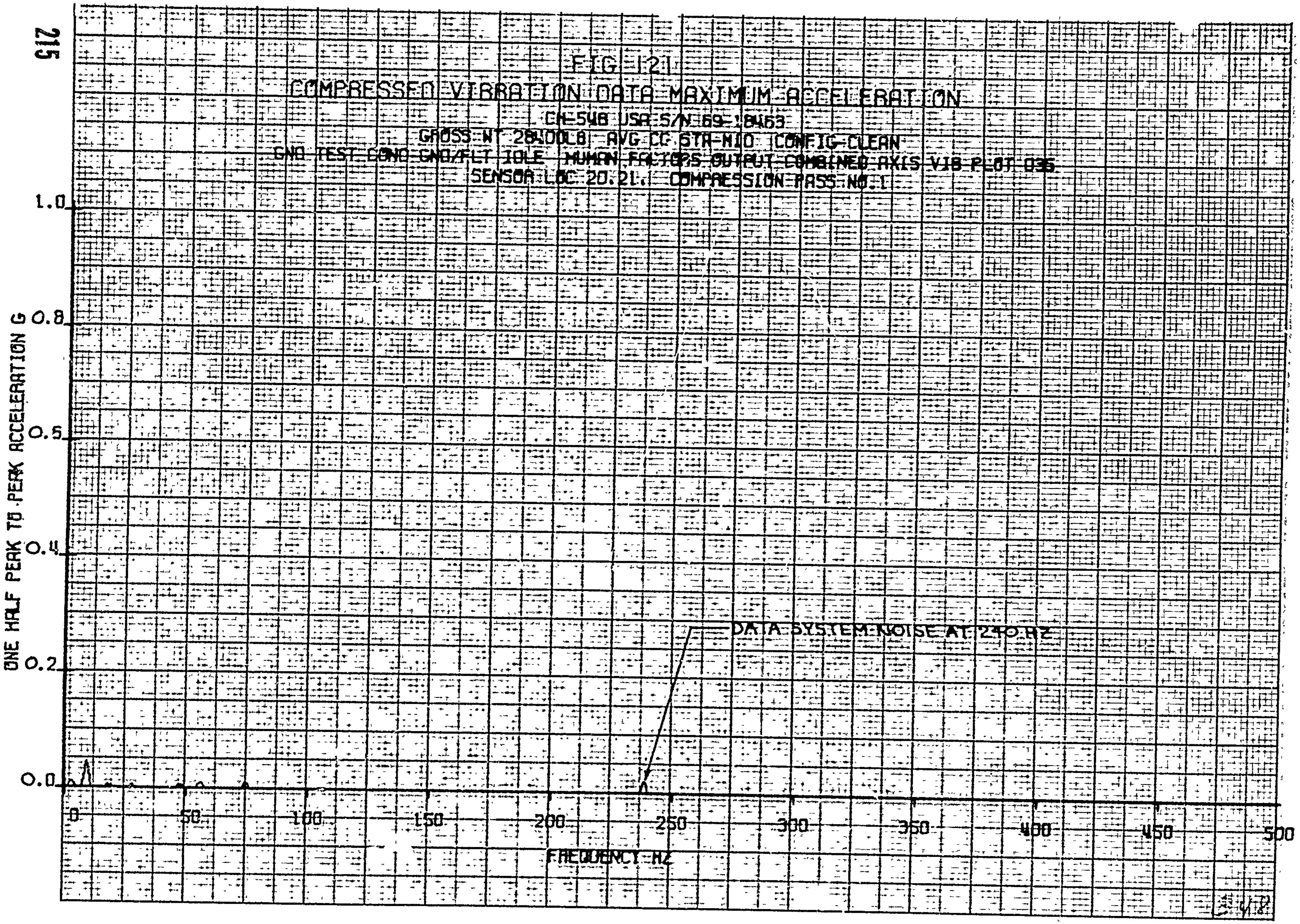


FIG 121
COMPRESSED VIBRATION DATA MAXIMUM ACCELERATION
CH-54B USA S/N 69-18463
GROSS WT 28400LB AVG CG STA-MID CONFIG-CLEAN
GND TEST COND GND/FLT IDLE HUMAN FACTORS OUTPUT COMBINED AXIS VIB PLOT 035
SENSOR LOC 20.21. COMPRESSION PASS NO.1
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
1.0
0.8
0.5
0.4
0.2
0.0
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY HZ

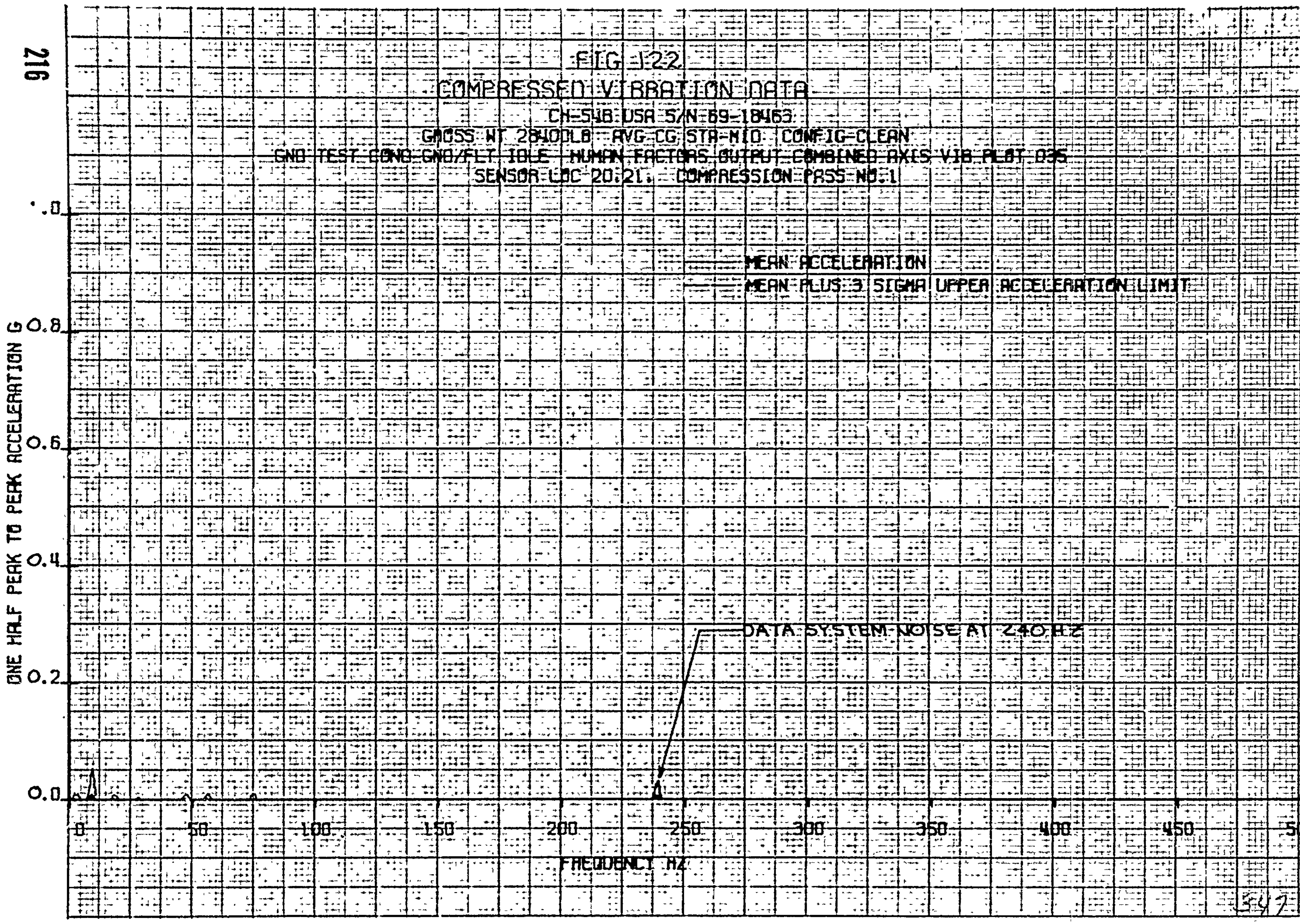
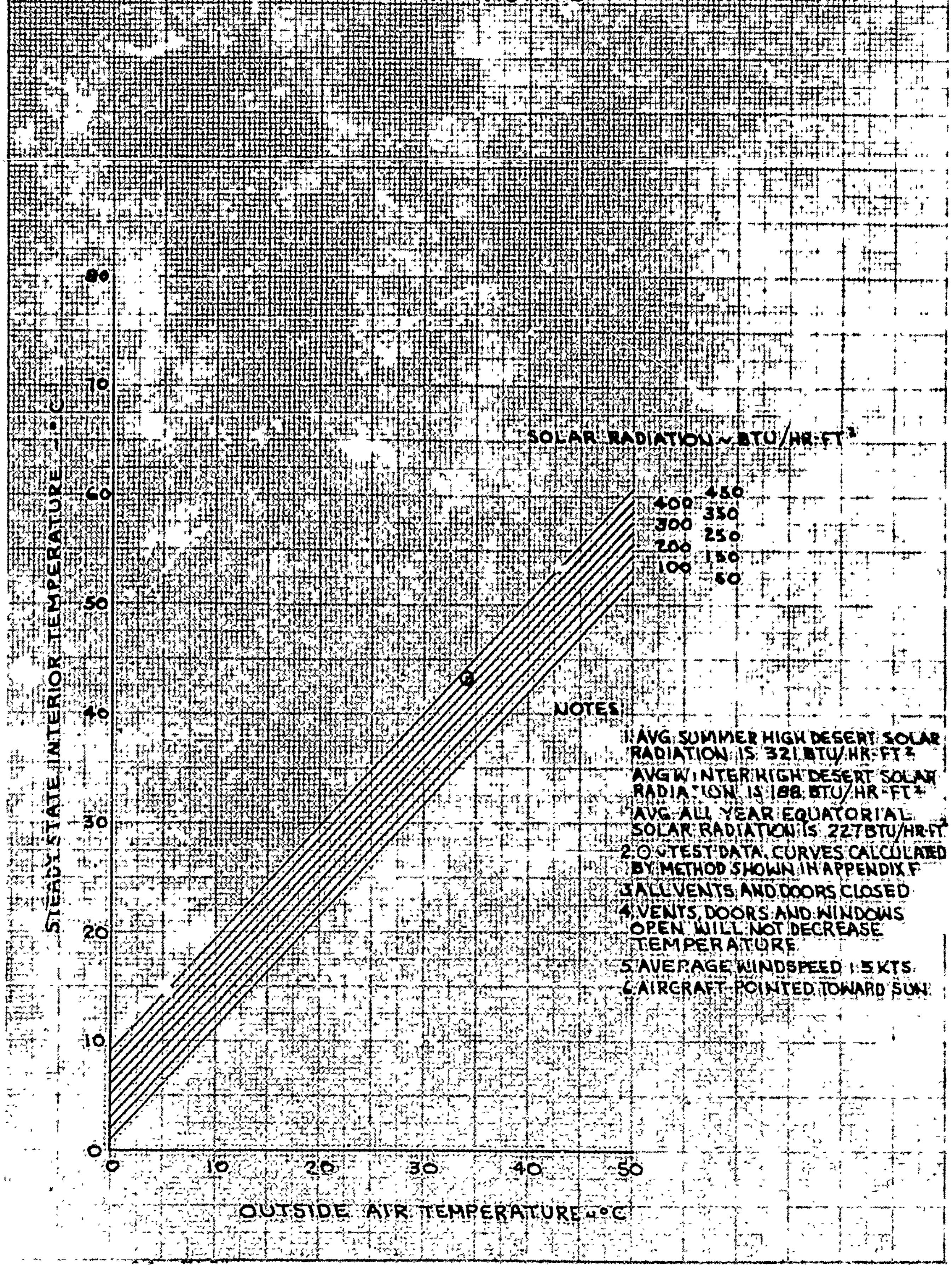


FIG 122
COMPRESSED VIBRATION DATA
CH-54B USA S/N 69-18463
GROSS WT 28400LB AVG-CG STA-MID CONFIG-CLEAN
GND TEST COND GND/FLT IDLE HUMAN FACTORS OUTPUT COMBINED AXIS VIB PLOT 035
SENSOR LOC 20.21. COMPRESSION PASS NO.1
MEAN ACCELERATION
MEAN PLUS 3 SIGMA UPPER ACCELERATION LIMIT
DATA SYSTEM NOISE AT 240 HZ
ONE HALF PEAK TO PEAK ACCELERATION G
0.0
0.2
0.4
0.6
0.8
FREQUENCY HZ
0
50
100
150
200
250
300
350
400
450
500
547

FIGURE 123
STATIC INTERIOR TEMPERATURE
CH-54B USA [illegible]
FRONT AVIONICS



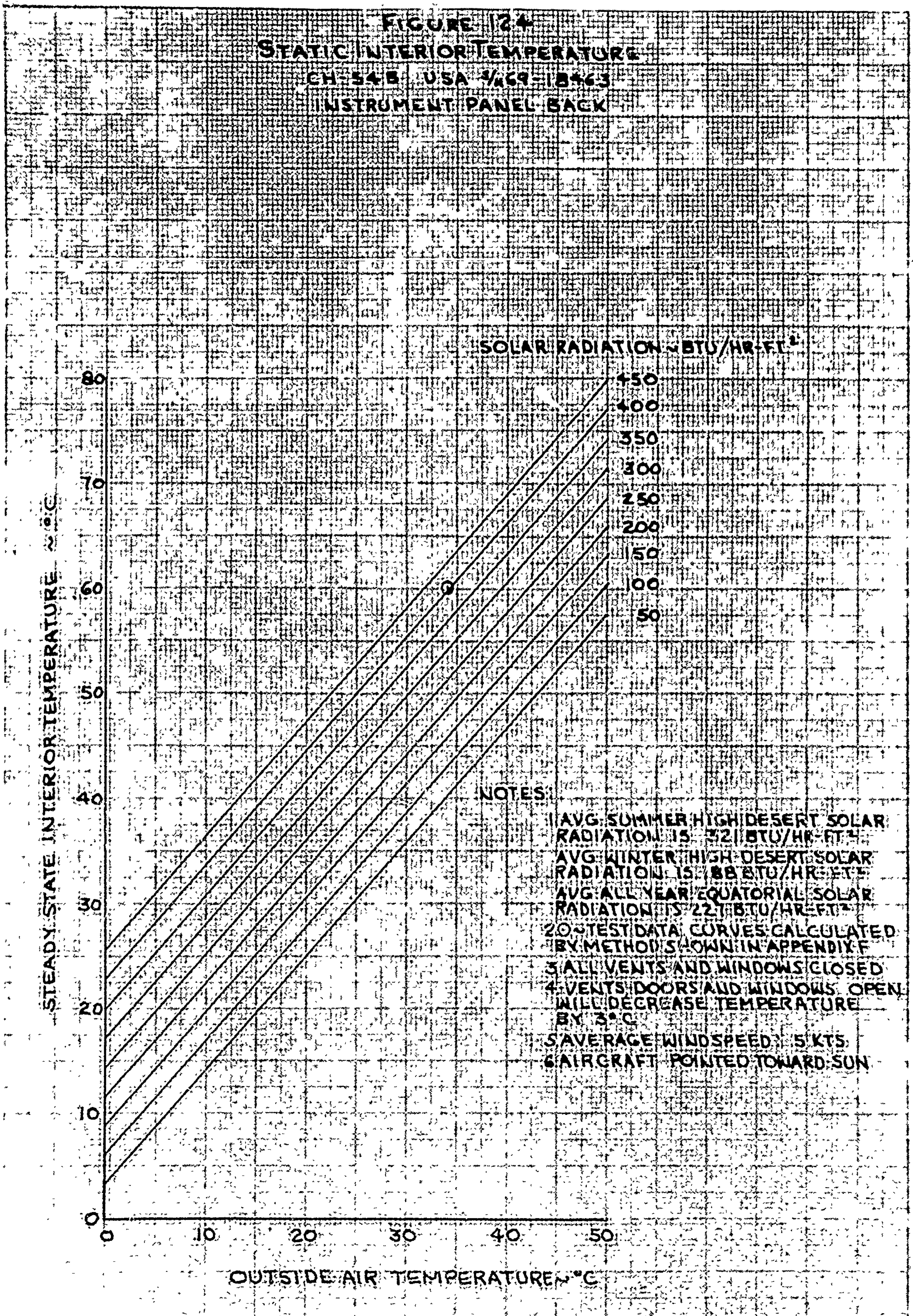


FIGURE 124
STATIC INTERIOR TEMPERATURE
CH-54B USA S/N 69-18463
INSTRUMENT PANEL BACK
SOLAR RADIATION ~ BTU/HR-FT²
450
400
350
300
250
200
150
100
50
STEADY STATE INTERIOR TEMPERATURE ~ °C
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
OUTSIDE AIR TEMPERATURE ~ °C
NOTES:
1 AVG SUMMER HIGH DESERT SOLAR RADIATION IS 321 BTU/HR-FT²
AVG WINTER HIGH DESERT SOLAR RADIATION IS 188 BTU/HR-FT²
AVG ALL YEAR EQUATORIAL SOLAR RADIATION IS 227 BTU/HR-FT²
2 ⊙ ~ TEST DATA CURVES CALCULATED BY METHOD SHOWN IN APPENDIX F
3 ALL VENTS AND WINDOWS CLOSED
4 VENTS DOORS AND WINDOWS OPEN WILL DECREASE TEMPERATURE BY 3°C
5 AVERAGE WINDSPEED: 5 KTS
6 AIRCRAFT POINTED TOWARD SUN

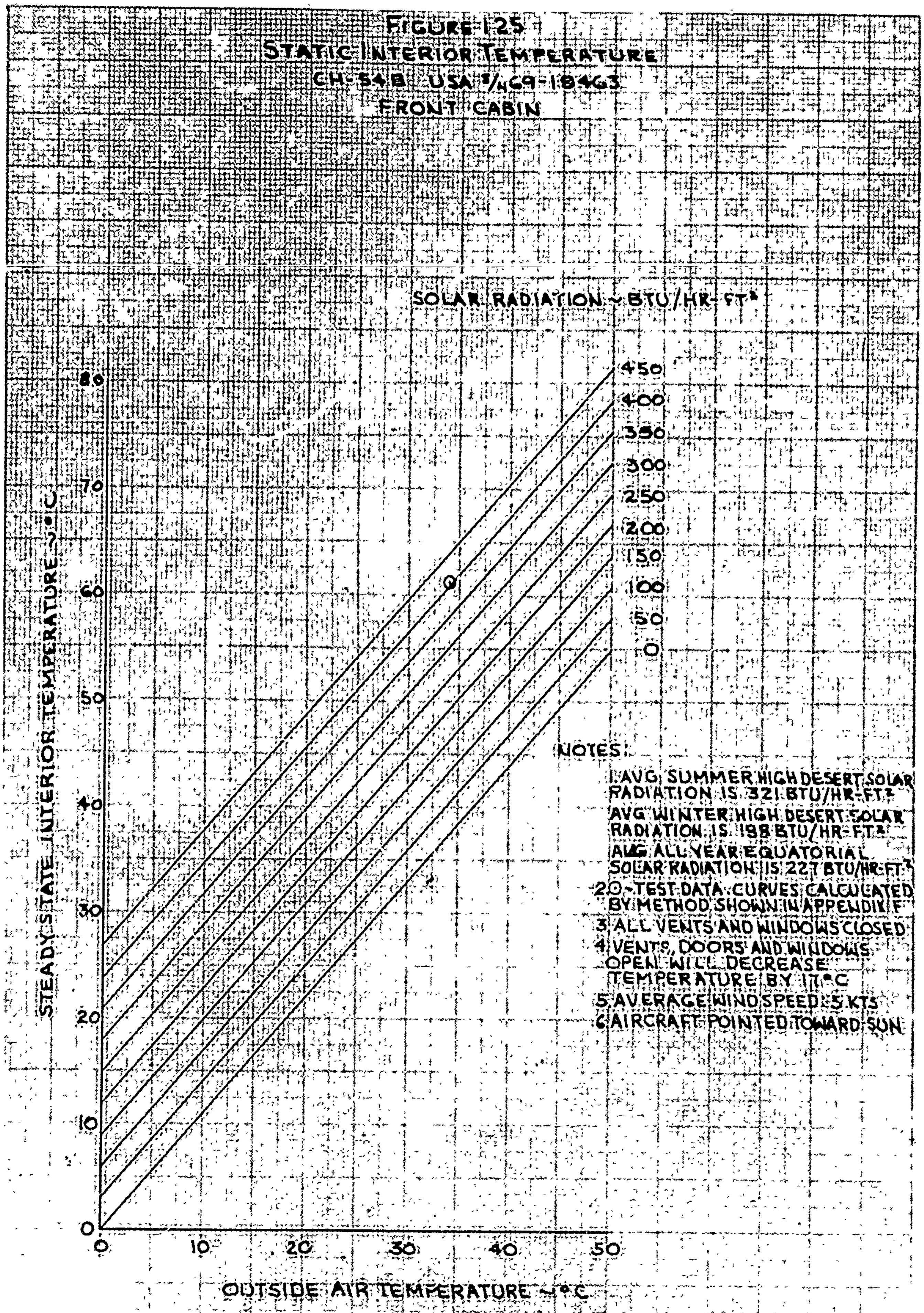
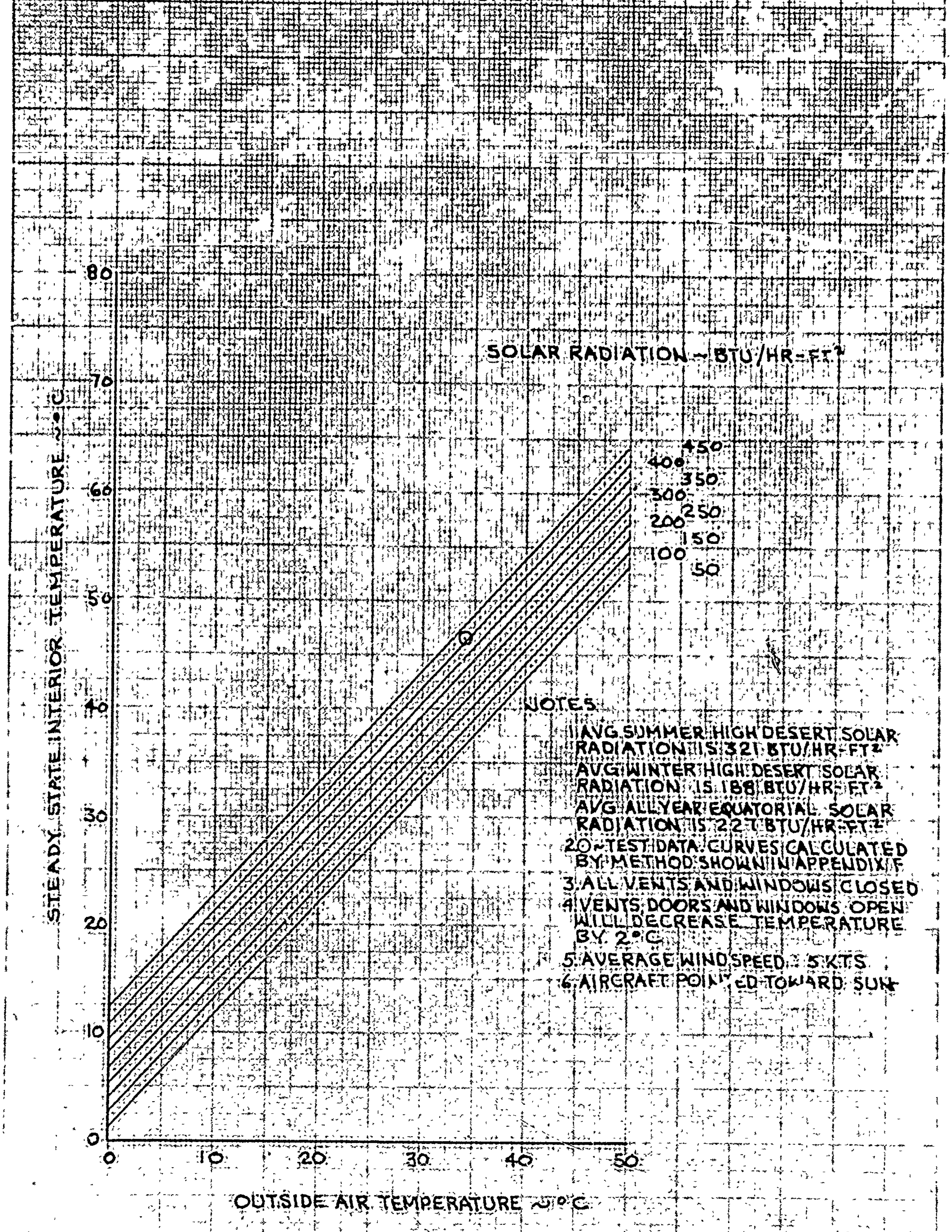


FIGURE 125
STATIC INTERIOR TEMPERATURE
CH-54B USA S/N 69-18463
FRONT CABIN
SOLAR RADIATION ~ BTU/HR-FT²
450
400
350
300
250
200
150
100
50
0
STEADY STATE INTERIOR TEMPERATURE ~ °C
OUTSIDE AIR TEMPERATURE ~ °C
0
10
20
30
40
50
60
70
80
NOTES:
1. AVG SUMMER HIGH DESERT SOLAR RADIATION IS 321 BTU/HR-FT²
AVG WINTER HIGH DESERT SOLAR RADIATION IS 188 BTU/HR-FT²
AVG ALL YEAR EQUATORIAL SOLAR RADIATION IS 227 BTU/HR-FT²
2. O - TEST DATA. CURVES CALCULATED BY METHOD SHOWN IN APPENDIX F
3. ALL VENTS AND WINDOWS CLOSED
4. VENTS, DOORS AND WINDOWS OPEN WILL DECREASE TEMPERATURE BY 17°C
5. AVERAGE WIND SPEED: 5 KTS
6. AIRCRAFT POINTED TOWARD SUN

FIGURE 126
STATIC INTERIOR TEMPERATURE
CH-54B USA S/N 69-18463
AFT CABIN



APPENDIX H. HELICOPTER VIBRATION SOURCES

There are three primary sources of vibration in present-day gas turbine-powered helicopters: the main and tail rotors; all other rotating components; and, if the helicopter is armed, gunfire. The rotor induced vibrations are of a low frequency with the fundamental frequency equal to the rotor speed. In present-day helicopters, the main rotor speed ranges from about 3 to 8 Hz with the rotor speed generally decreasing with increasing rotor diameter. A vibration occurring at the main rotor fundamental frequency is referred to as the one-per-rotor-revolution (1/rev). The rotor also induces harmonic vibrations at frequencies which are integral multiples of the number of rotor blades multiplied by the fundamental rotational frequency. Thus, a two-bladed rotor with a fundamental frequency of 5 Hz induces vibrations at frequencies of 5 Hz (1/rev), 10 Hz (2/rev), 20 Hz (4/rev), 30 Hz (6/rev), etc., and a three-bladed rotor at frequencies of 5 Hz (1/rev), 15 Hz (3/rev), 30 Hz (6/rev), 45 Hz (9/rev), etc. Normally, main rotor induced vibrations beyond the 10th harmonic, 100 Hz for a two-bladed rotor, are not significant. Rotor induced vibrations at harmonics of the rotor fundamental frequency are the predominant helicopter low-frequency vibrations and are caused by dissymetry of lift over the rotor disc which excite rotor blade structural modes and generally increase with airspeed. Vibrations are induced by all other rotating components in the helicopter. The frequencies range from the fundamental rotational frequency of the component up to geartooth, ball-bearing, and turbine-blade-passage frequencies which may range as high as 20 to 30 kilohertz. Gunfire induced vibrations are caused by recoil forces transmitted through the gun mount and by muzzle blast pressures. They have a fundamental frequency equal to the gun rate of fire and harmonics of this fundamental up to about the 20th harmonic. Typically, the highest vibration level will be at one of the gunfire harmonic frequencies. Fundamental gunfire frequencies range up to about 70 Hz.

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) US ARMY AVIATION SYSTEMS TEST ACTIVITY EDWARDS AIR FORCE BASE, CALIFORNIA 93523	2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED 2b. GROUP

3. REPORT TITLE

VIBRATION AND TEMPERATURE SURVEY
CH-54B HELICOPTER

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

FINAL REPORT 22 August through 29 September 1972

5. AUTHOR(S) (First name, middle initial, last name)

EMMETT J. LAING, Project Officer/Engineer
ROBERT K. MERRILL, MAJ, FA, US Army, Project Pilot
JAMES S. REID, CW4, Avn, US Army

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
MARCH 1973	230	11

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S) USAASTA PROJECT NO. 70-15-3
b. PROJECT NO. AVSCOM PROJECT NO. 70-15-3	
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	NA

10. DISTRIBUTION STATEMENT Distribution limited to United States Government agencies only; test and evaluation, March 1973. Other requests for this document must be referred to the Commander, United States Army Aviation Systems Command, Attention: AMSAV-EF, Post Office Box 209, St. Louis, Missouri 63166

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY US ARMY AVIATION SYSTEMS COMMAND ATTN: AMSAV-EF PO BOX 209, ST. LOUIS, MISSOURI 63166

13. ABSTRACT

Vibration and temperature measurement tests were conducted on a CH-54B helicopter to define the vibration and temperature environment for the instruments, avionics, pilot station, and other component parts for representative flight conditions. Testing was performed by the United States Army Aviation Systems Test Activity, Edwards Air Force Base, California, between 22 August and 29 September 1972. The testing consisted of 16 flights totaling 18.5 productive test hours. Vibration data were recorded from 70 accelerometer locations for 55 flight conditions, and narrow band spectral analyses were performed on the vibration data. The results of the spectral analyses were summarized by use of statistical methods. Forward fuselage vibrations were primarily low frequency and were caused by the main rotor. Aft fuselage vibrations were primarily high frequency and were caused by gearbox and other rotating component vibration sources. The highest vibration levels were recorded at the auxiliary power plant at main transmission gear mesh frequencies. There were two shortcomings: amplification of main rotor-induced vibrations by avionics vibration isolation mounts, and excessively high Wet Bulb Globe Temperature index at the pilot station under certain environmental conditions.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Vibration and temperature measurement tests						
CH-54B helicopter						
Vibration and temperature environment definitions						
Vibration data						
Accelerometer locations						
Narrow band spectral analyses						
Statistical methods						
Low-frequency forward fuselage vibrations						
High-frequency aft fuselage vibrations						